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AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS

VOLUME XIV MARCH 9, 1925 NUMBER 4

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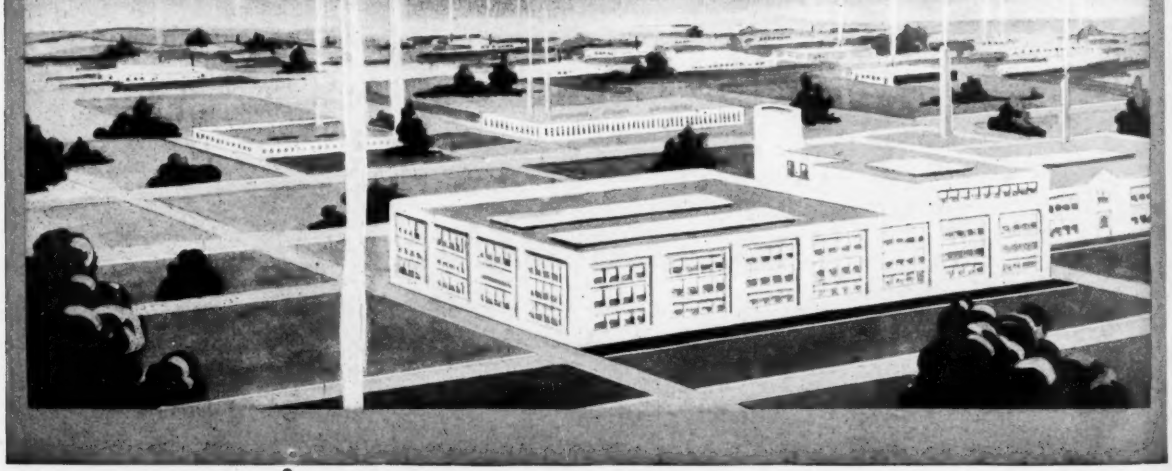


American Dyestuff Reporter, Vol. XIV, No. 4. March 9, 1925. Published twenty-two times a year by Howes Publishing Co., Inc., 90 William Street, New York, N. Y. Domestic subscription $5.00; Canadian, $5.50; foreign, $6.00. Entered as second-class matter Nov. 6, 1919, at the New York, N. Y., Post Office, under the Act of March 3, 1879. Copyrighted, 1925, by Howes Publishing Co.

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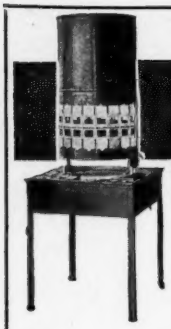

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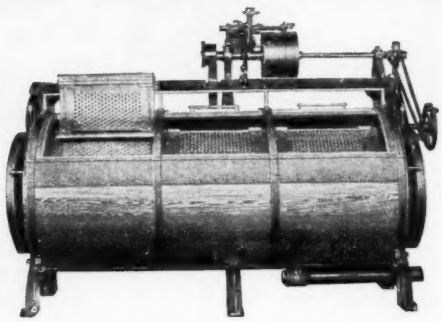

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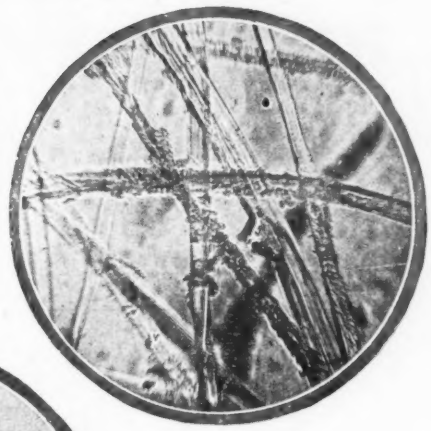
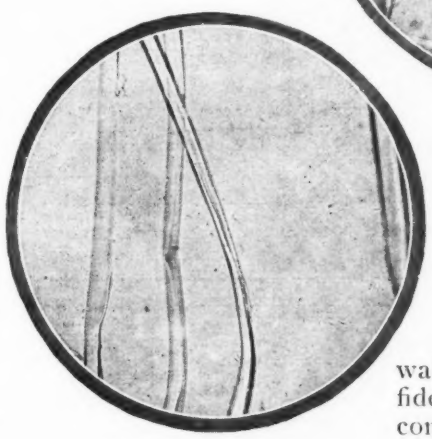


*This photomicrograph shows a faulty spot in silk that has been degummed in water containing a small amount of impurity. Note the deposits that cling to the fibres. These deposits, caused by hidden impurities in the water, are the cause of rejections which have heretofore been difficult to trace.*



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VOLUME XIV NEW YORK, MARCH 9, 1925 NUMBER 4


# Non-Chemical Problems of a Textile Chemist

**Some Typical Problems Involving Little Chemistry Encountered in the Mill and Solved by the Mill Chemist, Effecting a Saving of Considerable Time and Money**

By H. W. EASTMAN

FROM the chemical laboratory and classroom work of the technical school or college to the chemical laboratory and plant control work of the modern textile mill, there is a long road to be covered by the average student of textiles before the two conditions which are so very much alike, and yet so very different, can be properly co-ordinated. The student, for instance, is given a problem to solve which is attacked with more or less determination and intelligence. If the problem presents difficulties which, to the student, seem insurmountable, the instructor is interviewed and suggestions obtained which enable the student to proceed more intelligently with the work, until finally the problem is solved with more or less satisfactory results. In the majority of trouble cases arising in the mill that require chemical investigation, the cause of the trouble is absolutely unknown, or if the cause is known, then other circumstances often prevent the chemist from following out what appears to be the easiest and most logical method of solution, and he must of necessity adapt himself to the conditions presented by the particular problem with which he is confronted.

Invariably, the practical man handling the routine work is right, at least in his own estimation, and it is seldom that the chemist can accomplish the desired results by antagonizing such a man. It is always a reasonable assumption that the practical man has done the best work of which he is capable, having undoubtedly followed his general procedure for the work under consideration, such procedure having, up to the time the trouble developed, yielded perfectly satisfactory results. Furthermore, he is anxious to have the work go along smoothly, because the more routine the work, the more it can be delegated to assistants.

After the foreman has exhausted all the means at his disposal for overcoming the trouble, and has decided to report the condition to his superior, it is more than likely that the chemist will be thought of and, oftentimes, as a last resort, will be consulted and told that everything possible has been done to overcome the trouble, but without success. Ordinarily the chemist is informed that no change has been made in the regular procedure; that the machine is run at the same speed; that the temperature of the process has not varied; that the same chemicals are used as have always been employed; and that the same staple is being used in the construction of the fabric, and so on.

In trouble cases the writer believes that the first essential, looking toward the successful solution of the problem, is to obtain all the data possible regarding the particular process where the trouble has first appeared, although it may be, and very probably will be, that the trouble has actually occurred in some preceding process. Such data can only be obtained through observation and by careful questioning of the man doing the actual work. It is reasonable to assume that such a man has made certain observations and may have very decided opinions regarding the cause of the trouble, but these opinions can only be obtained by the chemist, to be used as his own after he has established friendship with the operative. The establishment of such a friendship is not difficult, but it must be handled with more or less diplomacy. Such a bond of confidence must be established if the best results are to be obtained.

It is the object of this paper to point out with more or less detail some of the problems which confront a mill chemist and to indicate the manner in which the solving of these problems is accomplished. On the one hand, occasions may arise where there will be an opportunity to display great chemical skill; on the other hand, the problem may require little or no chemical knowledge, but the chemist may rest assured that the one thing which interests the mill management is the solving of that particular problem in the quickest and least expensive way, and in a manner which will not interfere with regular plant production.

## Some Typical Problems

The following instances are typical examples of what may be encountered in a textile mill.

(1). Five hundred pounds of partially bleached cotton yarn has reached that stage of the process where it is to receive a sizing treatment; the yarn is already on bobbins; the bobbins are on the creel; the yarn is beginning to pass through the sizing material, and over the slasher. After the operation has proceeded in the regular way for some time, the operative becomes aware of the fact that more than the usual number of broken ends are appearing. The machine is stopped and the condition reported to the foreman. After an examination, some of the yarn upon the bobbins is found to be decidedly weak in spots, and the entire lot is removed from work and held pending further orders.

In the meantime, while that particular lot of yarn is out of work, it must be borne in mind that the entire lot is more than likely on special order, and that very soon the different sections of the organization, through which the orders pass, will be making inquiry as to progress.

The chemist when informed that trouble has occurred, requests that some of the bobbins showing the damaged yarn be sent to the laboratory for examination. The yarn proves to be decidedly weak in spots and when tested with litmus paper gives a distinct acid reaction which is found to be due to the presence of sulphuric acid. The chemist immediately knows that the only place where sulphuric acid could normally have come in contact with the yarn was in the bleaching operation, where the sour treatment follows the liming of the goods.

The yarn, when passing through the bleaching operation, was in hank form, each hank being tied together, in chain form, by means of heavy twine. By carefully unwinding the yarn from the bobbins, it was found that all the weak places were located at what would have been one end of the hank, which indicated that one or more of the strings used for tying the hanks together had been tied too tightly, and that the acid had not been thoroughly washed from the material at this point.

The problem now narrowed down to how many bobbins contained damaged yarn. Inasmuch as the yarn had to be calendered under tension it was suggested that the processing be continued, that each bobbin which thereafter showed damaged yarn should be discarded, but that those which showed no weakness might be considered satisfactory. As the operation continued, ten bobbins were eventually discarded representing five pounds of damaged yarn, whereas 495 pounds of yarn were perfectly satisfactory. The hanks weighed 2½ pounds each, thus showing that the acid had only remained under one of the strings, which had been too tightly tied, which meant the destruction of two hanks or five pounds of yarn.

The chemist had thus been able to effect a very material saving, even although the actual chemistry involved had only been the detection and identification of sulphuric acid.

(2). Another instance may be cited in which very little chemistry was involved, but in which the chemist was of assistance in solving the difficulty.

At one time complaint was made that the arms and hands of one of the scrub women in the mill had become badly affected with the scrubbing compound employed and the finger nails had become stained with a dark-brown coloration. The laboratory had been preparing a soft soap which was used in scrubbing the floors, and the first thought was that caustic soda or potash had been inadvertently added to the mixture. A test of the soap showed that it contained no excess of alkali. Furthermore, other scrub women using the same soap in different sections of the same room in which the trouble occurred did not experience any difficulty.

During the course of the investigation the chemist was eventually able to reach the section of the room where the woman who made the complaint was regularly engaged, whereupon he found the machines and floor covered with brown lint which had shaken off the yarn being processed, and what had at first caused considerable anxiety proved to be a harmless brown dyestuff, which, in solution, colored the hands.

The two instances which have been outlined involve very little actual chemistry, the first only requiring the determination of the presence and identification of an acid; the second, only the determination of the absence of free caustic alkali in the soap solution.

The solving of these problems, beyond the slight amount of chemistry involved, only required a working knowledge of the processes, and the ability to properly diagnose the trouble. The one thing which interested the management was that the troubles were quickly and correctly solved, the first instance effecting a very material money saving and the second instance maintaining the morale of the workers.

## ARTHUR D LITTLE NEW CHAIRMAN OF CHEMICAL EXPOSITION COMMITTEE

Arthur D. Little, president of Arthur D. Little, Inc., of Boston, was elected to succeed Charles H. Herty as chairman of the Advisory Committee of the Exposition of Chemical Industries at a meeting of the committee held at the Chemists Club, New York, on February 24th. Dr. Arthur D. Little is one of the most widely-known chemical engineers in the United States and one of the pioneers in the modern American chemical industry. He is president of one of the largest research and engineering organizations in the world. Dr. Charles H. Herty, who resigned from the chairmanship of the Advisory Committee owing to the pressure of other duties, has been chairman of the committee for ten years, serving since the inception of the Chemical Exposition in 1915. He remains a member of the committee.

Dr. Little has been a member of the Exposition Committee for the past ten years. This, the Tenth Exposition of Chemical Industries, will be held at the Grand Central Palace, New York, September 28th to October 3, 1925.

One of the features which the committee decided to include in this exposition was a Court of Achievement in which those new products of chemical development during the past few years would be shown.

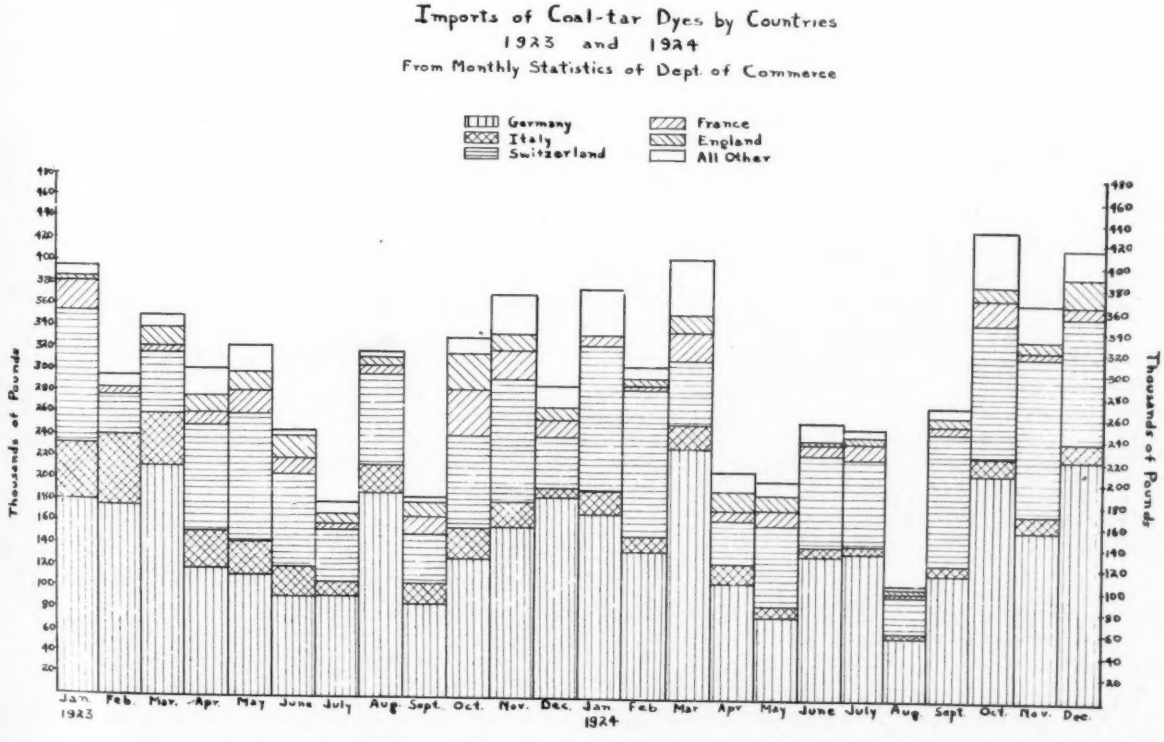
# Imports and Exports of American Dyes for 1923 and 1924

## With a Chart of German Dyestuff Production for the Past Five Years

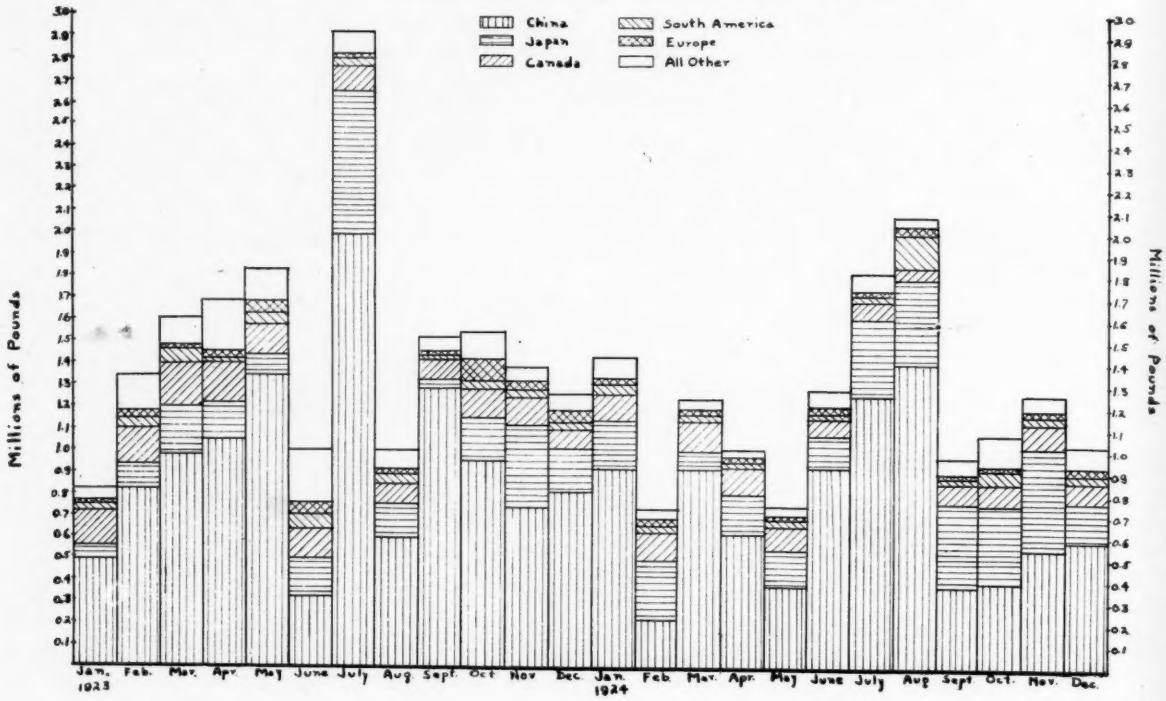
THE charts published on this and the following pages were prepared by the Synthetic Organic Chemical Manufacturers Association of the United States. The first chart shows imports of coal tar dyes into the United States during 1923 and 1924 and indicates clearly the proportions imported from each foreign-producing country. The sudden rise in October, 1924, to a point above the figures for the entire period was due, of course, to the 15 per cent reduction in the ad valorem rate of duty which automatically went into effect, under the 1922 tariff act provisions, on September 21, 1924.

Exports of dyes from the United States to leading foreign countries during 1923 and 1924 are shown by a second chart. The great rise in July, 1923, coincides significantly with the sharp drop in German dye production from January to June of that year caused by the French occupation of the Ruhr territory. It will be obvious that our exports are influenced largely by German competition which in turn depends in some degree upon German production. This export chart shows how predominating is the market for our dyes in China, fully 50 per cent of the exports, on an average, going to that country, with Japan following in second place. Similarly the chart showing exports to the principal Latin-American countries indicates clearly the predominance of Argentine and Mexico as consumers of American dyestuffs in this group of countries.

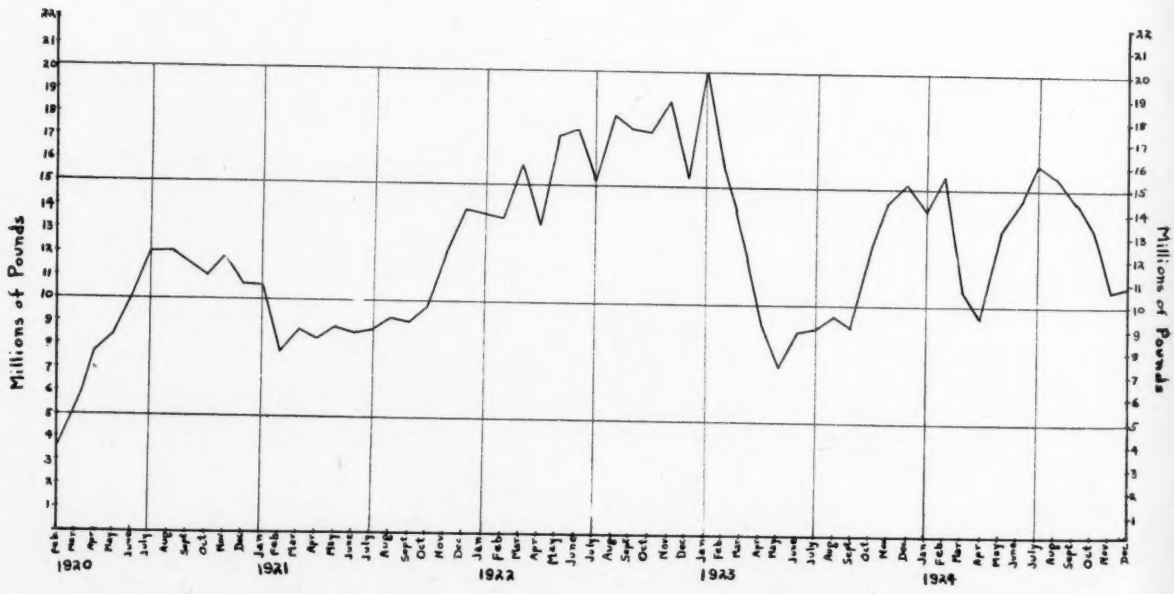
The chart showing the monthly German production of dyes for the past four years is based upon figures supplied to the Reparations Commission and compiled by the commission from records of all reparations deliveries of dyes for the period shown. As referred to above, the sharp descent during the first four months of 1923 was the effect of the Ruhr occupation. Since then German production has been fluctuating unsteadily and has not again, up to January 1 of this year, attained the high point reached at the end of 1922. It is safe to predict, however, that a similar chart for this year will show a decided increase.



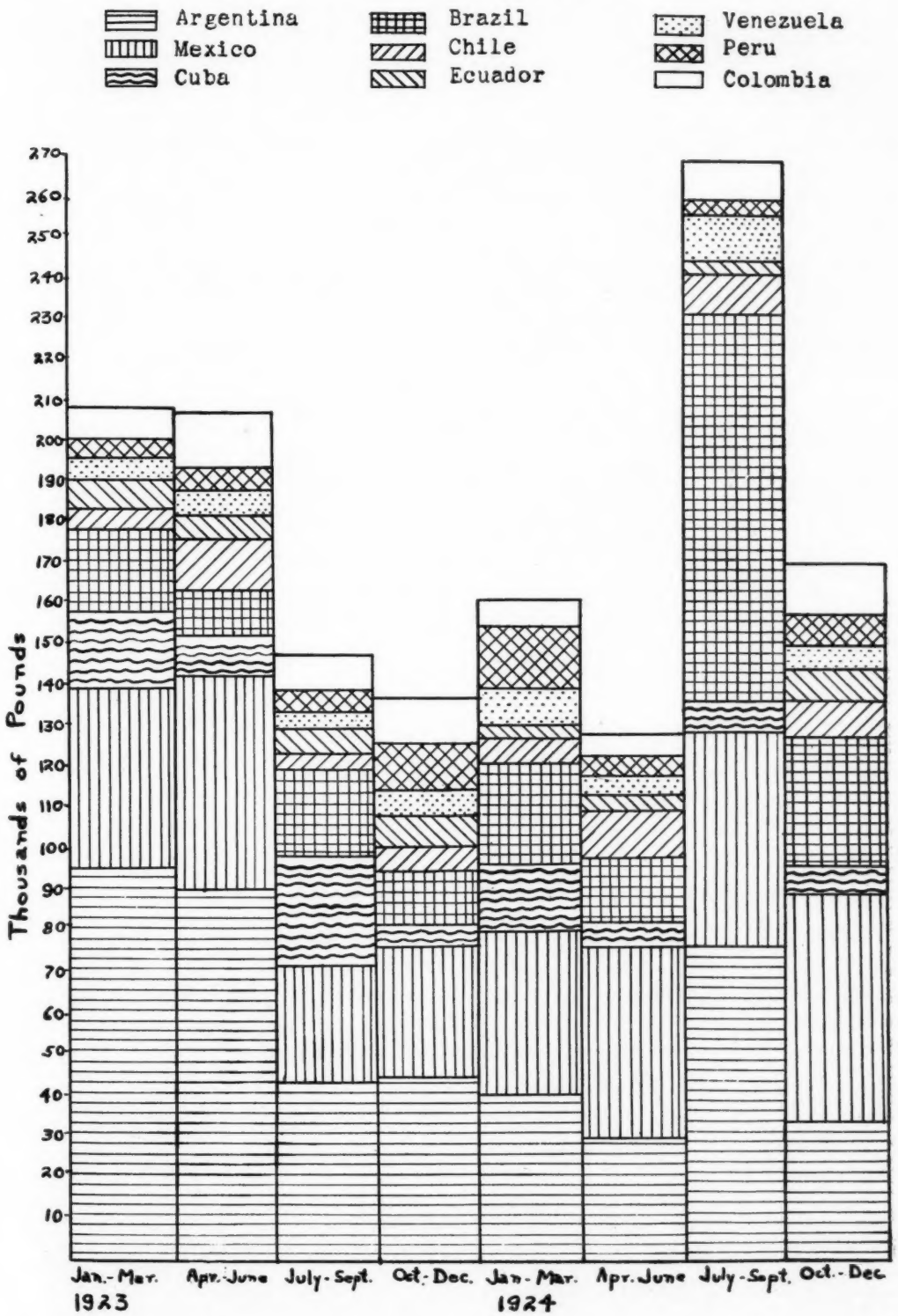
Exports of Coal-tar Dyes by Countries
1923 and 1924
From Monthly Statistics of Dept. of Commerce




Monthly German Dye Production
February, 1920 to December, 1924



Exports of Coal-tar Dyes to Principal Latin-American Countries
January, 1923 to December, 1924
From Monthly Statistics, Dept. of Commerce



## EXPLODING THE GERMAN DYE MYTH WITH FACTS

As soon as American dye manufacturers were able to produce a line of colors equaling and in some cases even exceeding in fastness qualities their foreign prototypes, the press agents of the industry began their wordy war against the long-established myth that upheld the exclusive superiority of German dyes. The widespread denunciation of that myth and the equally widespread and persistent praise of American dyestuffs finally succeeded in bringing out, first, the fundamental truth that the manufacture of fast dyes is not an exclusive German secret, and, second, that after patient research and experimentation American chemists had produced a range of dye products that were establishing, both at home and abroad, an enviable reputation for quality.

The effect of the German dye myth, however, still lingers in spite of the battering it has received; even today it is a live topic, and for this reason any propaganda aimed at it deserves earnest consideration. One article of unusual interest, containing information not heretofore included in similar exposes, recently appeared in Textile World, under the caption "American Dye Quality vs. The German Dye Myth," by Douglas G. Woolf. The article explains the growth and popular acceptance of the fallacy that only German dyes are good dyes. Unfortunately, German propaganda against American dyes was supported during the war period by complaints of poor fastness coming alike from the public and the textile mill. A majority of such complaints, as it is now well known, were traced to the wrong application of the limited range of dyes then available, whether originating from American or foreign sources. At its very birth, then, the American dye industry was stigmatized.

The article by Mr. Woolf tells all of this very interestingly, and tells also how, by striving always for product of the highest type, American manufacturers at last attained for their dyes merited recognition.

When the Government published its last edition of Census of Dyes and Other Synthetic Organic Chemicals, our industry learned with pride, and probably with justified amazement, that it had been supplying 96 per cent of domestic consumption. But the percentage of each of the various types of dyes being supplied by American plants and the percentage being imported are not common knowledge. The above-mentioned article supplies this information, which we summarize herewith.

Of acid dyes, 96.8 per cent of the total domestic consumption is made in this country. The acid dyes not produced here include mainly the following colors: Milling Yellow, Alizarine Sky Blue B, Wool Fast Blue BL, Cyanol FF, Azo Carmine GX, Anthraquinone Violet, Alizarine Direct Violet, Alizarine Irisol, Brillians Wool Blue FFR, Indocyanine, Fast Green Extra Bluish, Guinea Brown and Sulphone Orange.

Of direct and developed dyes, 96.9 per cent are made here. The 3.1 per cent imported consist in the most part of the following dyes: Benzo Fast Brown, Chloramine Red 8BS, Brilliant Benzo Fast Violet, Zambesi Brown, Diazo Brilliant Black, Diazo Brilliant Green, Diazo Fast Violet, Diazo Fast Yellow and Diazo Sky Blue.

Of basic dyes, 94.9 per cent are supplied by American manufacturers. The 5.1 per cent supplied from abroad comprise mainly the following types: Rhodamine 6G, Methylene Heliotrope, Rhoduline Sky Blue and Hansa Yellow.

Nearly all sulphur dyes consumed here are made in this country, only 0.6 per cent being imported. The principal sulphur dyes not included in the domestic range are Immedial Purple, Sulphide New Blue and Immedial Brilliant Green.

Of mordant and printing dyes, 89.9 per cent of total domestic consumption are made in America. The remaining 10.8 per cent imported consist largely of Eriochrome Azurol, Chromazurine, Alizarine Blue S, Acid Alizarine Gray and Chromocitronine.

Of vat dyes, domestic producers supply on a poundage basis 96.4 per cent of domestic consumption. Among the missing products in this class are Ciba Bordeaux, Indanthrene Red, Algol Brown, Algol Brilliant Violet, Ciba Violet and Anthraflavone.

It will be understood, of course, that the above percentages are as close an approximation as is possible from existing statistics. These facts and figures may be said to form an index to dyestuff manufacturing possibilities in this country. The sooner these lists are reduced the sooner will the foreign dye import figures decrease.

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## DR. MATOS ADDRESSES N. C. COLLEGE

Dr. Louis J. Matos, textile chemist for the National Aniline & Chemical Company, recently addressed the students and faculty of the North Carolina State College, Textile Department. The subject of the lecture was Warp Dyeing, the history of which was traced up to the present methods used in modern mills.

During the present school year, lectures have been delivered to the textile students by the following well-known men: John H. Haddock, efficiency engineer, Erwin Cotton Mills, Durham, N. C.; Charles H. Stone, Grasselli Chemical Company, Charlotte, N. C.; L. R. Gilbert, superintendent, Caraleigh Cotton Mills, Raleigh, N. C.; A. C. Stohn, of the A. C. Stohn Company, Boston, Mass.; A. E. Snyder, of the firm of Percy Legge & Co., wool merchants, Boston, Mass.

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Exports of colors, dyes and stains in January amounted to 2,007,000 pounds, valued at $658,000, surpassing those of any other single month throughout the year 1924, with one exception. Owing to losses in exports of coal-tar crudes and intermediates the value of the entire export of coal-tar products fell off from $1,283,000 in January, 1921, to $917,000 in January, 1925.

# Proceedings of the American Association of Textile Chemists and Colorists

## The American Association of Textile Chemists and Colorists

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## JANUARY MEETING OF THE NORTHERN NEW ENGLAND SECTION

The Northern New England Section held a very successful meeting at the Engineers' Club on Saturday, January 31, 1925. Approximately seventy members and guests sat down to the dinner.

Dr. Walter M. Scott gave an address, entitled "Application of Hydrogen Ion Determination to Textile Work," and Arthur E. Hirst presented a paper, entitled "Printing of Cotton Fabrics and Related Processes." Both papers are published herewith. The author of each paper led the subsequent discussion of his subject.

Previous to the presentation of the papers Prof. Louis A. Olney, President of the Association, said a few words in regard to the Chemical Equipment Association Exposition, which is to be held in Providence next June, and Walter S. Williams extended the greetings of the Rhode Island Section, of which he is Chairman and spoke briefly in regard to plans which were in progress for a joint meeting of the Northern New England and Rhode Island Sections in Providence at the time of the Chemical Exposition.

ARTHUR K. JOHNSON, Secretary.

## Application of Hydrogen Ion Determination to Textile Work*

By DR. WALTER M. SCOTT

*Cheney Bros. Company*

[NOTE.—*Acknowledgment is made of the services of Dr. E. M. Shelton and Miss Hazel Grover in the collection of the data here presented.*]

Mr. Chairman and Gentlemen—Inasmuch as I am not listed in the Northern New England Section, I did not see any announcement of this meeting until it was shown to me to-day by one of your members. According to the announcement I am down to present a paper on this subject of the application of hydrogen ion determination to textile work. As a matter of fact, when I wrote in an acceptance I did not guarantee to present a paper, but said I would be very willing to talk for a while in order to open up discussion on the subject. My remarks will, therefore, be more or less informal.

For the benefit of some who perhaps are not very familiar with this subject, it might be well to start out with a general definition of hydrogen ion concentration so that we can get the basic principle before us. The fundamental equation which deals with hydrogen ion concentration is that in any solution of an electrolyte, the product of the hydrogen ion concentration, which we represent as CH+ and the hydroxyl ion concentration, which we represent as COH— is a constant under the same temperature conditions. As a matter of fact, the variation at different temperatures is slight and may be disregarded under normal working conditions. This constant has been determined for the temperature of 22 deg. Cent., and it is $10^{-14}$.

Now, in the case of pure water or of a perfectly neutral solution, the concentration of the hydrogen ions must be equal to the concentration of the hydroxyl ions. You can therefore very readily see that the hydrogen ion con-

*An address before the Northern New England Section, January 31, 1925.

centration at the neutral point will be $10^{-7}$. Of course, you realize that $10^{-7}$ is the method of expressing the actual fraction. It really means one over 10,000,000. The hydrogen ion concentration increases with additions of acid, and decreases with the addition of alkali.

This is rather a cumbersome figure to work with, so Sorensen proposed a simpler figure which he calls pH, and is the logarithm of one over the hydrogen ion concentration. In other words, where the hydrogen ion concentration is $10^{-7}$ the pH will be 7. Therefore, in dealing with this particular term we are actually dealing with whole numbers, which makes it somewhat simpler in its terms, although you have to remember that pH is exactly the reverse of hydrogen ion concentration. That is, where the hydrogen ion concentration is greatest, the pH is least. However, I might say that most all of the students who deal with this subject speak in terms of pH, and in the remainder of my talk practically all of my figures will be based on this method of expression.

There are two general methods for the determination of hydrogen ion concentration: One is electrometric and one is colorimetric.

The electrometric determination is based upon a comparison of the difference in potential between the cells of an unknown hydrogen ion concentration and a standard cell of which the electrode potential is well known.

In our laboratory we have used most of the time a saturated calomel cell, and there is a definite equation which applies to a saturated calomel cell. It is this: If V represents the potential difference of the unknown solution, $V = 0.245 + 0.591 \log \frac{1}{CH+}$, or if you transfer that to terms of pH it is: $V = 0.245 + 0.591$ pH.

If you determine V, this potential difference, you can figure by the above equations either the pH or the hydrogen ion concentration.

Another method, as I said, of determining the pH is the colorimetric method, and that is one which we find is much more adaptable for actual plant work, because it is something that is not dependent upon a delicate instrument. You can take your various indicator solutions to any part of the plant with a portable apparatus and make the determinations quite quickly, that is, always providing you do not have an interference in the solution itself; by that I mean if you have a colored dyestuff solution which would mask the indicator change. Briefly, the principle of the colorimetric method is that there is a certain range of indicator dyes which have definite color changes within definite intervals of pH. Those have been worked out by a number of authorities on the subject. Clark, in his book on determination of hydrogen ions, gives you quite a complete table of indicator changes. Here you have a chart representing all the ranges of pH from one up as high as 10. As a matter of fact, we have found that in the alkaline range, four indicators were of particular value to us.

Phenolphthalein is an indicator which changes from colorless to pink as you go toward the alkaline, and the change from colorless to pink comes between a pH of 8.5 and 9. Then above 9 there is an increasing depth of pink.

Next in line is cresolphthalein, which also changes from colorless to sort of a bluish red, and that change also takes place between 8.5 and 9, and then you get the increasing depth of this bluish red as you go higher, above 9.

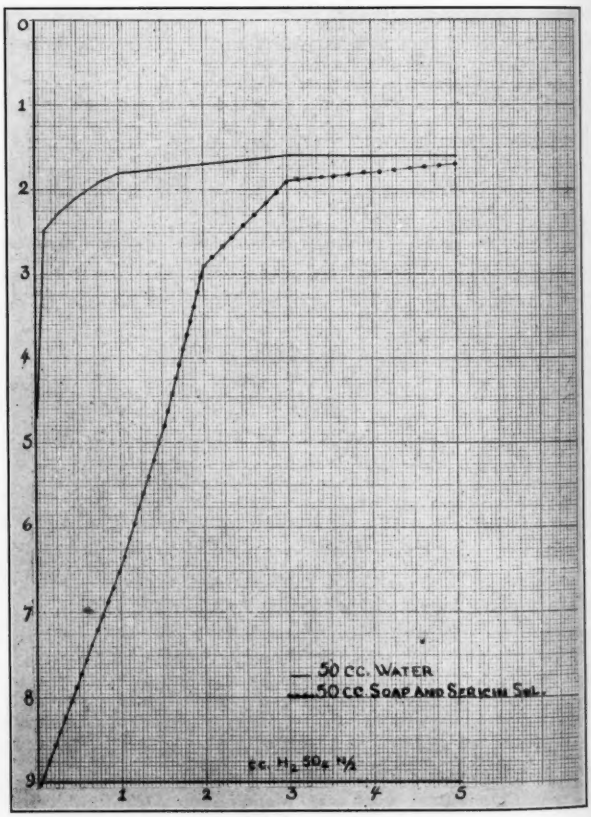
I might digress a little at this point to show the value of these two indicators in connection with soap work. The pH of a neutral soap solution, say a 1 per cent soap solution, is just within the range of change in these two indicators, and very often with a good neutral soap cresolphthalein will remain colorless and phenolphthalein will turn pink.

Then we have thymol blue, which is a bright blue at 10, goes through a gray at 9 to a brownish yellow at 8.

Then phenol red, which is pink at 8.5 and goes through a reddish brown at 7.5 to a brownish yellow at 6.5.

In the neutral range we have brom-thymol blue, which is blue at 7.6, goes through green at 7.0 to yellow at 6.0.

In the acid range brom-cresol purple, which is purple at 7, gray at 6 and brownish yellow at 5.



Brom-cresol green, which is blue at 5.6, green at 4.8 and yellow at 4.0.

Brom-thymol blue, reddish blue at 4.6, greenish gray at 3.8 and yellow at 3.0.

Thymol blue (acid) is orange at 2.8, scarlet at 1.8 and red at 1.2.

These indicators cover practically any working range that you would meet.

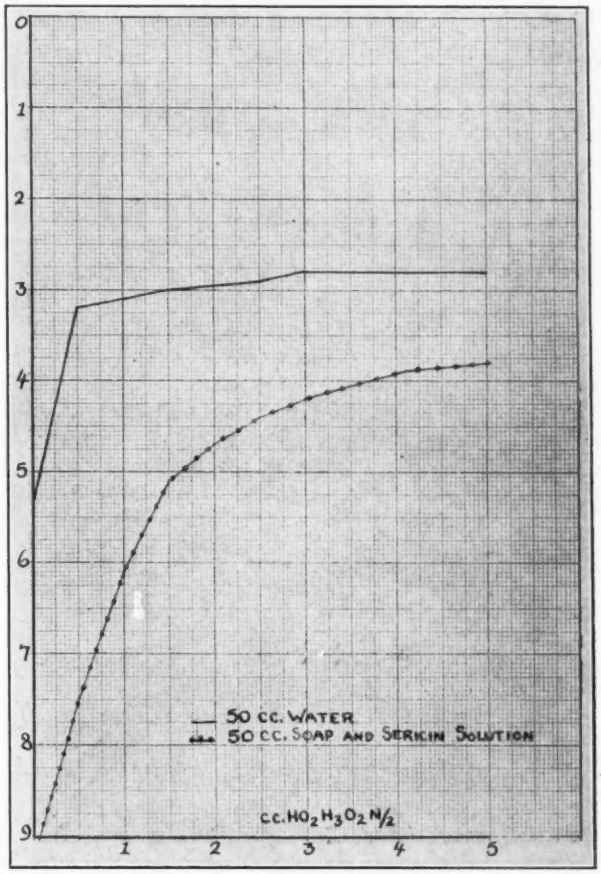
I have taken some little time in giving you an outline of these methods so as to make it clear in your minds just the way that we arrived at some of the figures and determinations which I will now speak about.

When we come to the application of this hydrogen ion determination to practical work in a textile plant I shall necessarily have to speak more or less from the standpoint of silk, because that is what I have been working with. As a matter of fact, there is a very close parallel, in my next subject, between silk and wool. I am going to speak for a few minutes on its application in the degumming of silk, and, of course, the parallel to that is the scouring of wool.

We find that the standard soap solution which we use quite considerably in the plant, containing 100 pounds of neutral soap—when I say neutral soap I mean soap that analyzes less than ¼ per cent of free alkali—dissolved in 600 gallons of water, giving you approximately a 2 per cent solution. The pH of this solution is approximately 8.8. Now, if we put into this soap solution a lot of 200 pounds of gum silk and boil it, in accordance with the usual method of degumming, until the gum is removed, we find that the pH of this soap solution is reduced approximately 0.2. So it transpires that after the treatment of this 200 pounds of silk, your solution will have a pH of approximately 8.6.

Now, we have found by experiment that if the soap solution is only reduced to 8.6 we can put in another lot of silk and boil it off in that solution. But if our pH is down to 8.4, or below—that is really only an approximate figure, but it is somewhere in that neighborhood—we cannot completely degum an additional lot of silk in that solution. But we do find that if we take this solution which is down to this point and add a strong alkali, such as caustic soda, which will bring back the pH to the original pH of our neutral soap, i. e., we can enter another lot of silk in that same solution and completely degum it. So you see in that case we find that it is possible without adding any more soap at all to degum another lot of silk. I think that this example is sufficient to illustrate that phase of the subject.

I would like to talk for a few minutes on what we call the buffer action of proteins, particularly with reference to gum or sericin. The same principle again, I think, would apply to wool, although we have not made any experiments on that fiber.




When I speak of buffer action, perhaps, it is well for me to give you just an illustration of what I mean, and perhaps I can do that best by reproducing some curves which are given in Clark's textbook to illustrate buffer action.

One of the best known examples of buffer action is the titration of phosphoric acid with sodium or potassium hydroxide. Starting with 50 c.c. of M/10 phosphoric acid solution which has a pH of 1.6, and titrating with N/10 KOH we do not get a regular gradual increase in the pH as we would expect. Instead, the curve is in the form of steps, due to the retarding or buffer action of the intermediate salts which are formed, i. e., acid potassium phosphate ($KH_2PO_4$) and normal potassium phosphate ($K_2HPO_4$).

Then there is another example of buffer action given in Clark which compares more nearly to our own problem in silk work, and that is the titration of beef infusion medium with hydrochloric and lactic acids. If you start with 100 c.c. of this beef infusion medium, which has a pH of approximately 7.7, and add N/5 hydrochloric acid to it, you have a smoothly rounded curve which flattens

out as the concentration of hydrochloric acid increases. In the case of lactic acid, which is a weaker acid, the curve flattens out even sooner.

To get a picture of just how this beef infusion medium has acted as a buffer you must make a comparison of what the pH would be if you did not have the beef infusion medium present. If we take just 100 c.c. of water and add 5 c.c. of N/5 hydrochloric to it, we would reduce the pH immediately to about 2, whereas the curve indicates that 5 c.c. of N/5 hydrochloric acid only reduced the 100 c.c. of beef infusion medium to a pH of approximately 6.7. Thus, the presence of the beef infusion medium has served to neutralize the effect of the acid to a great extent, and in that respect it is said to exert a buffer action upon the acid.

Now, in order to show the application of this principle in the processing of silk, I will present some curves that show the result of experiments made in our own plant on the action of sulphuric acid and also acetic acid upon a gum soap solution, i. e., that solution which we get from degumming silk, which contains the original soap plus the gum removed from the silk.

You all know that this solution, which is generally known to the trade as gum suds, is used afterward in dyeing silk, and is a very valuable assistant for the leveling of the dyestuffs on the silk fiber. I am confident that a large part of its value for this purpose is due to its buffer action with respect to the acids used in the dye bath. In considering the curves you will note that if we start with water alone and add an increasing amount of sulphuric acid we get a curve which jumps from about 5 straight up to the neighborhood of 2 before we have added even 1 c.c. of sulphuric, and then it gradually branches off into more or less of a straight line. There is very little change in the pH value between quite noticeable differences of sulphuric after you get to that point. But if we take 50 c.c. of a gum suds solution—and we did not use for our work the straight gum suds which we got from the boil-off bath, but diluted it in the proportion of 20 c.c. of the gum suds to 30 c.c. of water, thereby making our 50 c.c. of solution, comparable to the original 50 c.c. of water and titrate that with the sulphuric acid, we get a curve starting from a pH of about 9 and going off more gradually until it finally approaches the other curve. In the intermediate period you will find that the gum suds have exerted a definite buffer action upon the sulphuric, and the extent of that buffer action is quite remarkable when you consider the weakness of this gum suds solution. As a matter of fact, our analysis of the pure gum suds showed that it contained only 2.5 per cent total solids which is divided into 0.9 per cent of sericin and the remainder, 1.6 per cent, of anhydrous soap. When we diluted our gum suds with water in the above proportion it brought the total solids down to 1 per cent, divided into 0.36 per cent of sericin and 0.64 per cent of anhydrous soap. So you see that sericin is present in solution only to the extent of 0.36 per cent and is capable of exerting this marked buffer action and retarding the effect of the sulphuric acid in the bath.

That action is even more pronounced with acetic acid. As we add cubic centimeters of acetic acid to water, the acetic acid being a weaker acid does not bring the solution to as low a pH as the sulphuric acid. In fact, it comes down to about 3 and then goes into a nearly straight line, whereas the sulphuric acid as I have shown goes below 2.

The action of the gum suds flattens the acetic acid curve out more quickly and, although we have not carried it clear out to finality, it certainly does not indicate that the acetic acid and gum suds will ever reach the value of the straight acetic acid and water.

Another very apt illustration of this buffering action, which seemed quite remarkable to me, was in connection with the building up of the alkalinity of the soap bath to which I referred a little while ago, when I stated that we could degum another lot of silk if we built up the alkalinity of the bath by caustic soda. When we were making our experiments along these lines, we used a soap solution of a volume of approximately 1,000 gallons, the analysis of which was 1.3 per cent total solids composed of 0.5 per cent sericin and 0.8 per cent of anhydrous soap. The alkalinity of this solution was in the neighborhood of 8.4 per cent. Now, we added to that 6 quarts of 30 degree caustic soda which is sufficient caustic soda on a basis of our 1,000 gallons of total volume to give a 0.01 normal NaOH solution. Such a solution would have normally a pH of 12.12. However, the addition of this 6 quarts of 30 deg. Be. caustic solution to the 1,000 gallons of gum soap only changed the pH from 8.4 to 8.8. If anyone had told us in advance that we could put into that solution 6 quarts of 30 deg. Be. caustic and boil off the silk without dissolving the entire amount of silk into the solution, we would have been inclined to disbelieve him. But when we had the evidence of the pH determination we went ahead and took a chance and the silk came out just as good as it did from our original neutral soap solution.

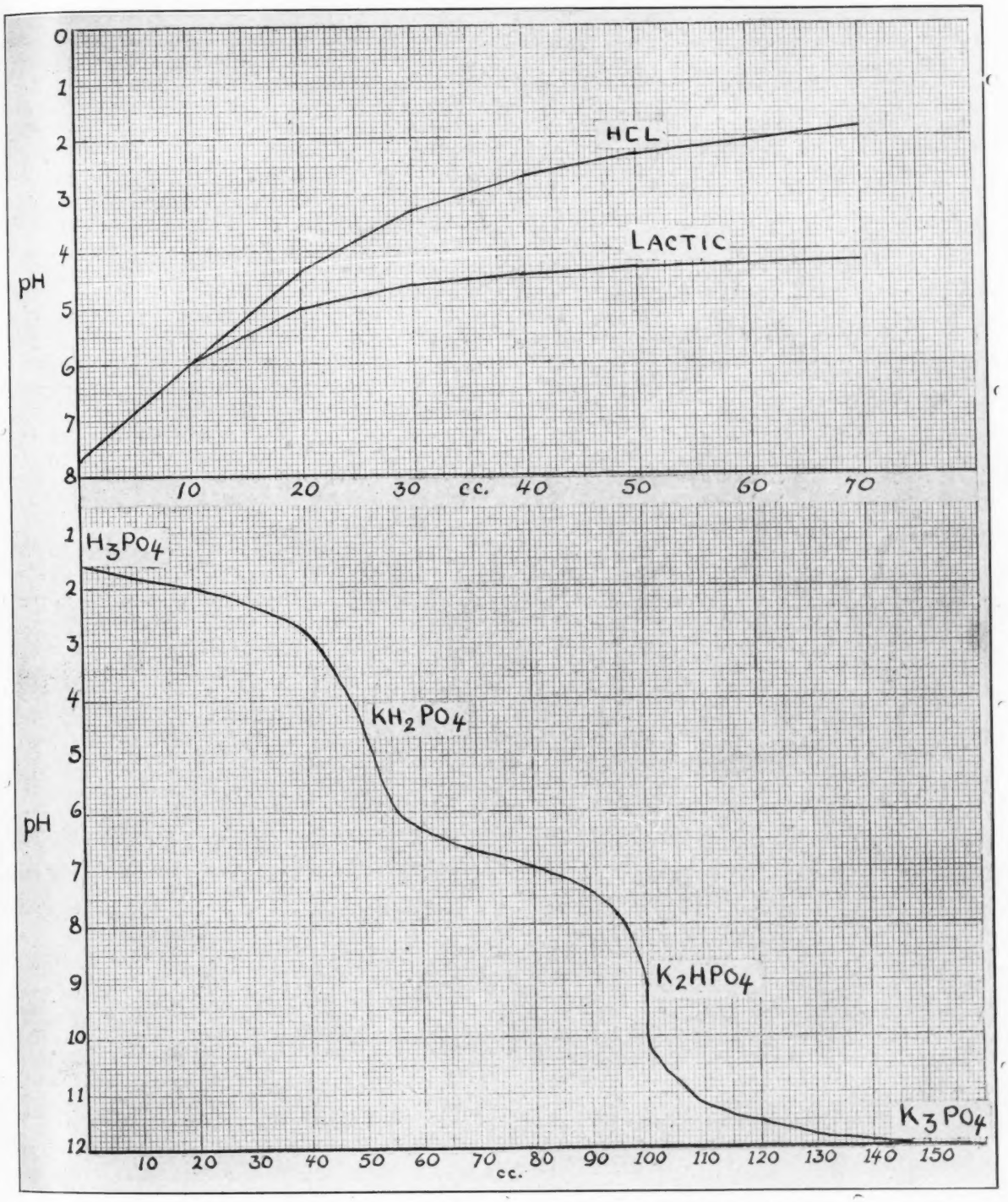
I am afraid that I am taking up more time than is allotted to me. I will try to be brief in the remainder of my remarks and give time for some discussion.

I would like to say just a few words on the possibilities of the hydrogen ion determination in connection with dyeing operations.

I was very much interested in a paper presented by White, Marker and Gordon at the April meeting of the American Chemical Society in Washington, and published in the Journal of Industrial and Engineering Chemistry, volume 15, page 1186.

They worked with a ferric oxide gel and an alumina gel, and studied the absorption of dyestuffs by these gels

100 *c.c. Beef Infusion Medium Titrated with N/5 HCL and N/5 Lactic Acid*




*50 c.c. M/10 $H_3PO_4$ Titrated with N/10 KOH*

under varying conditions of hydrogen ion concentration. The following table shows the results which they obtained with two acid dyes, Orange II and Metanil Yellow:

*Ferric Oxide Gel*

| Orange II | | Metanil Yellow | |
|---|---|---|---|
| pH | Mgs. adsorbed per gm. of gel | pH | Mgs. adsorbed per gm. of gel |
| 2.3 | 429 | 1.92 | 361 |
| 3.2 | 75 | 2.3 | 340 |
| 5.27 | 70 | 3.38 | 255 |

*Alumina Gel*

| Orange II | | Metanil Yellow | |
|---|---|---|---|
| pH | Mgs. adsorbed per gm. of gel | pH | Mgs. adsorbed per gm. of gel |
| 2.3 | 452 | 1.92 | 703 |
| 3.2 | 186 | 2.3 | 460 |
| 5.27 | 179 | | |

You will note that when the ferric oxide gel had a hydrogen ion concentration of 2.3 it absorbed 429 milligrams of Orange II per gram of gel. When its pH was increased to 3.2, it absorbed only 75 milligrams of dyestuff to a gram of gel, and at 5.27 pH it dropped down to 70. With the Metanil Yellow there was a more gradual reduction. Starting with an adsorption of 361 milligrams at 1.92 pH, it dropped to 255 milligrams at 3.38 pH. Both dyestuffs behaved in a similar manner with the alumina gel.

This paper was interesting to me because it tallied with our own practical observations in the dyeing of silk, and it also applies in the dyeing of wool.

We know that in the dyeing of silk a strong acid-like sulphuric, which in a one-hundredth normal concentration has a pH of approximately 1.8, will give a much more complete and quick absorption of acid colors in silk than acetic acid, which is a weaker acid, and in one-hundredth normal concentration only has a pH of about 3.4. This points to the fact that the pH of the dye bath has a marked effect upon the exhaustion of the dyestuffs.

We are therefore confronted with the necessity of maintaining a constant hydrogen ion concentration in our dye bath, by some means or other, in order to obtain standardized dyeing. In other words, if we have a definite percentage of dyestuffs to produce a definite shade at one time, and we wish to reproduce that shade again with just the same percentage of dyestuffs, I think the question of the hydrogen ion concentration is a most important one to look after. It is one of the variables that has not perhaps been thought of so much as certain others, i. e., temperature, volume of dye bath, etc.

Then when we come to the dyeing of vat and sulphur colors on silk we also run up against the factor of the pH of the dye bath.

We know, particularly in connection with the vat colors, that their affinity for silk increases noticeably with the reduction of pH. If we take a strong caustic solution of a vat color and neutralize it to bring down its pH with bicarbonate of soda, the affinity of that solution for silk will increase very noticeably, and we obtain the maximum efficiency of those colors at a pH very close to where the dye will precipitate out of solution. In other words, to produce the best dyeing of silk we have to reduce the pH of the vat solution just as far as we can without actually precipitating out the color in the dye bath.

This question of pH is also very valuable in connection with the actual strength of the silk fiber, because to give you an illustration, silk immersed half an hour in a 1 per cent caustic soda solution at 140 deg. Fahr. will lose 34 per cent of its tensile strength. It is almost ruinous to dye silk in a very strongly alkaline solution, particularly with caustic soda, at any sort of an elevated temperature. But we find if 80 per cent of this caustic is neutralized, instead of the tensile strength decreasing 34 per cent it will only decrease 13 per cent. So when we control our pH, and bring the solution closer to the neutral point, we also increase the strength of the silk fiber as it comes from the dye bath.

I have tried in a general way to present some of the ideas which I have on the possibilities of applying hydrogen ion determination or hydrogen ion control to textile work, and I will be very glad to answer any questions on the subject. I would also like very much to hear the ideas of someone else if they have had some experience along this line.

## Discussion

*Chairman*—Gentlemen, Dr. Scott is ready to discuss the matter with you or to answer any questions.

*Mr. Hobby*—Mr. Chairman, I would like to ask Dr. Scott how he measures pH value in a vat solution which not only has a pH value but also has a reducing value of its own.

*Dr. Scott*—Why, we have not actually got to the point of saying that we have an accurate measurement of pH of those solutions. We do measure it colorimetrically to a certain extent by the use of filter paper dipped in various indicator solutions. That is, you can get the indication of the pH of the solution by taking a filter paper which has been saturated with this indicator solution and dried, and just dip it in the vat solution and note the change at the point of contact.

*Mr. Hobby*—Where it diffuses in.

*Dr. Scott*—Yes, where it diffuses at the point of contact. That is only approximate, but that is about the best way we have at the present time.

*Mr. Chapin*—Do you measure the reduction potential?

*Dr. Scott*—We have not.

*The Chairman*—This subject opens up so many possi-

bilities that I think by the next meeting we will have a lot more questions to ask Dr. Scott. You all seem to be having stage fright, and I warn you to be prepared to follow up this subject further, because from what the Doctor has already shown there is a chance for a lot of us to use the method later on.

## Printing of Cotton Fabrics and Related Processes*

By Arthur E. Hirst

*American Printing Company*

The subject of "Printing of Cotton Fabrics and Related Processes," is perhaps a little too extensive to describe in detail in the time at my disposal, so with your permission I will touch briefly on the more important machines and processes and concentrate somewhat more on the printing of vat colors.

### The Printing Machine

For the benefit of those not acquainted with the working of a printing machine let us first take up a general description of it. In effect we have first a large iron cylinder serving as a background against which the engraved copper roller bears with considerable pressure. This cylinder is wrapped with a number of layers of woolen lapping to give a resilient background. For this same purpose is often used a woolen or rubber blanket which runs around with the cylinder in a manner similar to an endless chain.

The engraved copper roller, which is to furnish the pattern for the goods, bears with perfectly uniform pressure, or set, against this blanket and lapping, with the cloth to be printed and the "back gray" interposed between the two. This back gray serves to diminish the soiling of the blanket and lapping by any color which may be pressed through the printed goods. When run sufficiently often to become badly stained the gray is run to the bleach house for bleaching, and if the staining has not been too extensive can then be used for printing.

Directly under the roller is placed the color box, which contains the printing color paste. This paste is distributed uniformly over the roller by means of a wooden roller called the "furnisher," rotating in the color. The furnisher may be plain or furnished with bristles. As the engraved roller is rotated by means of the main drive, the color on the plain surfaces is removed by a steel "doctor," leaving the engraving filled with color. This doctor blade must have a perfect edge, free from imperfections, otherwise fine streaks of color would pass along the smooth surface and be printed on the cloth. The color remaining in the engraving is then transferred by the pressure onto the white cloth, which passes direct to the dry-cans.

*A paper presented before the Northern New England Section, January 31, 1925.

### Engraving

The method of engraving the copper rollers varies according to the pattern. In case of large areas of color to be produced on the goods such as are found on cretonnes, the pentagraph process is used. Briefly, this process is carried out as follows:

The design to be followed is placed upright in a so-called "camera." An arc throws its light against the design, the beams of light being then deflected through a lens into a dark room, where an image of the pattern, enlarged to a definite degree, is received on a painted zinc plate placed on an upright frame. The sketch maker traces with a pencil around the outlines of the various parts of the pattern, the number of plates varying with the number of rollers to be engraved for the design. This plate, after being roughly colored by hand, is passed to the plate cutter who cuts the pattern into the plate, leaving grooves in place of the sketchmaker's penciling.

The pentagraph is now used on the plate. The motions made by following with the pin around the grooves left by the plate cutter are reproduced on a reduced scale by other pins on top of the machine. These are furnished with diamond points. The copper roller to be engraved has previously been varnished and placed horizontally under the above-mentioned diamond points which scratch the varnish away as they move over the roller, thus reproducing the desired pattern on the original scale. After completing the process, the roller is revolved in an acid bath, the exposed copper being thereby etched. Polishing finally completes the preparation of the roller for printing

For simpler patterns, such as small figures, lines, etc., a simpler method, mill engraving, is used. A brief description is as follows: The pattern is engraved, by hand or by a modification of the pantagraph process, on a soft, steel cylindrical die. This is hardened and rotated under high pressure against a similar cylinder of soft steel called a mill, leaving the pattern in relief on the latter. After hardening the latter is rotated in a lathe against the roller to be engraved, thus pressing the pattern into the copper.

### Color Mixing

A printing color consists principally of dyestuff, solvent, thickener, and mordants or other chemical necessary for the fixing or development of the color. All three types of additions to the color, of course, vary with the nature and purpose of the dyestuff. A requirement common to all thickeners is freedom from foreign material such as sand or other fine substances which would pass through the straining cloths and damage the roller by scratching or momentarily lift the doctor blade and allow a streak

to pass through. As to the solvent, water and acetic acid are the most common. Mordants vary greatly, e. g., tannic acid for basic colors, chrome for many so-called mordant colors, salts of alumina or iron for alizarine reds and purples. Special materials are also used, as hydrosulphites for vat colors and albumen for pigments.

Almost all the classes of cotton dyestuffs can be used for printing. Direct and acid colors, being very fugitive to washing, are used only for cheap goods which are not to be washed. Basic colors are very largely used where bright shades are wanted, as on cretonnes. Mordant colors, as Alizarine Veridine, Alizarine Blue and Yellow, are often used on the cheaper grades of dress goods and shirtings. Vat colors are, of course, the most desirable to use, when the cost is permissible. Besides the usual topical printing we have a large variety of resists and discharges. As examples of the former we have white and colored resists for Aniline Black. Here an alkaline zinc oxide paste is printed with or without color on the white cloth. The goods are passed open-width through an Aniline Black liquor, through a nip, dried and aged. The production of the black is prevented where the pattern is printed.

Para Red and similar ice colors can also be resisted in the same way by printing a thickened mixture of tin crystals, gelatine and paraffin wax.

There are a number of types of discharges, depending on the ground color to be printed on. A white pattern can be produced on dischargeable direct colors, Para Red, Indigo, etc., by printing on the dyed ground a hydrosulphite, with subsequent aging. Tin crystals are also used for certain colors. For colored discharges we must select for the printing color one which will withstand the action of hydrosulphite. After the aging the goods must receive a light soaping to remove the decomposition products of the reduction.

## Steaming

After printing, the ordinary steam colors, as basic, mordant and pigment colors, are subjected to a prolonged steaming process, the time being about three-fourths of an hour. This is carried out in a large brick chamber about 50 feet long by 8 feet wide and 40 feet high. By means of a suitable mechanism the goods are carried slowly in long loops through the box in an atmosphere of live steam above 200 deg. Fahr. The high temperature and moisture brings about a combination of the dyestuffs and mordants, making a compound of greater fastness, more than is possessed by the dyestuff alone. In some cases it also gives a compound producing the shade desired, as in the case of Alizarine Red or Blue.

For other types of color, such as vats, Aniline Black and hydrosulphite discharges, a smaller steam box, called an ager, is used. The construction and details of these machines vary according to the print being aged. The principle is similar to that of the steam box, in that the reaction is brought about by the high temperature and moisture of the steam. In addition to the heat supplied by this steam, a series of closed coils raises the temperature. To prevent condensation, a steam chest is placed so as to form the top of the ager. The prevention of water drops in very essential, as such a drop coming in contact with the print before complete aging will cause spreading of the color at that point.

In certain cases, notably that of vat colors, aging must furnish a copious amount of moisture. For this purpose the free steam is thoroughly saturated by one of a number of simple means, such as bubbling through water. To remove the excess steam entering the box, an exhaust fan is placed near the opening of the box through which the cloth is withdrawn.

In aging, the goods pass rapidly through the box, the time of passage varying from one to three minutes. While in the endless steamer the goods travel, as described, in a procession of loops; in the ager they are drawn over rollers vertically through the box; in other words, they do not hang in the box for any length of time.

## Soaping

After the aging or steaming the print is washed to remove excess color and thickening, and in some cases to increase the fastness by forming a more complex and insoluble lake. For steam colors the open soaper, through which the goods pass in the open width, is used. It consists of several compartments, each of which serves its special purpose. For instance, in the prints involving basic colors the first beck holds a solution of an antimony salt. The other becks usually contain water or soap solution. Aniline Black may receive first a treatment with bichrome or soda ash, while other colors are merely washed with no preliminary treatment.

Some prints, notably the vat colors, require a rope-soaping. The rope soaper is essentially similar to the log washer familiar in the bleach house except that, by piling loosely in the water between each squeezing, the time of immersion is longer. The first beck contains water, the following ones soap solution. The goods pass continuously from one beck to another. Evidently prints must be made from fast colors to be capable of withstanding this severe treatment.

After soaping, the goods pass to the finishing operations familiar to all.

## Vat Colors

Now let us consider a little more particularly the printing of vat colors, the most desirable class where fastness is required. These dyestuffs come from the manufacturer

in two forms—paste or powder. The better form for printing is the paste, a very finely divided suspension, in which condition it is easily reduced.

These colors are invariably printed in an alkaline medium, a requirement for solution of the leuco compound. The alkalinity is furnished by soda ash, potash, or caustic soda, choice being made according to the dyestuff in question. The suspension now being in proper condition for reduction, one or another form of hydrosulphite is added. We will not consider here the less usual reducing agents, as ferrous sulphate. Some printers find the addition of sodium sulphoxylate, hydrosulphite conc. powder, of advantage to bring about reduction before printing. In any case the stable hydrosulphite, formaldehyde, is now added in the form of a water or glycerine solution. This compound brings about little or no reduction before aging.

It is characteristic of vat colors that plenty of moisture is required for reduction. To satisfy this demand a deliquescent agent is used, commonly glycerine.

The reacting materials now being present, the thickening is added. This is usually a paste of British gum containing a substance to prevent frothing during printing. Turpentine serves this purpose satisfactorily. Besides freedom from grit, an important requirement of a gum is resistance to thickening in the presence of a strong alkali. A gum which gels under such a condition will make an unworkable color paste.

The printing of vat dyes presents some conditions differing from those met with in steam color printing. Taking into consideration the fastness to washing, care must be taken with respect to the treatment of back-grays. If the printing of a heavy pattern has soiled the gray badly and the latter is to be used later as white goods for printing, it must be wet out and run into the bleach as soon as possible to prevent aging and consequent fixing on the fiber.

As is evident from the alkaline nature of the printing paste, special care must be taken when vat colors and Aniline Black pastes are to be printed together, the latter, of course, being sensitive to alkalies. This can easily be illustrated by printing a vat color across an Aniline Black before oxidizing the latter. When aging it is seen that the development of color is prevented at the point of crossing and a white spot is left. Similarly if a vat color stripe is printed in contact with an Aniline Black stripe a white stripe is found between the two. As a result also of this action, one must pay due attention to the proper sequence of rollers in such a case.

Let us assume that we are printing a two-color pattern, a vat blue and an Aniline Black. If the black is printed first the pattern marks the blue roller, eventually etching it appreciably. Thus, the blue roller begins to print this etched line over the black, and, of course, the development of the black is prevented.

Suppose the order of the rollers is reversed, the blue being printed first. Unless precautions are taken, the alkaline paste marks off on the black roller and gradually accumulates in the black paste, until sufficient alkali has collected to decompose the color. This can be largely prevented by using a lint-doctor, a brass blade similar to the steel-doctor, resting on the front of the roller and removing the greater part of the lint and scum coming from the blue paste. So with care on the part of the printer such a combination can be run.

After printing and dyeing, the vat color print is to be aged in the "hydrosulphite ager." The aging should be carried out as soon as possible, the goods not being allowed to stand overnight before undergoing this process. Long standing in a warm, damp atmosphere may cause deterioration of the print so that when it is rope-soaped, the parts which have been exposed lose considerable color, the pattern sometimes being almost entirely washed off.

In the case of hydrosulphite prints the ager must be maintained practically free from air. Such a condition can be kept by withdrawing steam and air rapidly by means of a fan placed near the opening in the ager. The steam must carry a large content of moisture, and should keep the box at a temperature of 210 to 220 deg. Fahr. A large volume of steam is important, especially in the aging of Indigo prints. Under such conditions the hydrosulphite formaldehyde compound readily breaks up and reduces the dyestuff to the leuco form, in which form it is soluble and combines with the fiber. As mentioned before, water-drops must be guarded against to prevent running of the pattern where moistened.

The ager may be run at a speed of 75 to 100 yards per minute, the goods being steamed for about three minutes or more. Thorough reduction is in most cases indicated by a maximum change in shade, Ciba Blue, for example, coming out a greenish yellow, Indanthrene Yellow a deep navy, etc.

Reoxidation is the next process, the purpose being to restore the original shade and to render the dyestuff insoluble and hence fast to the cloth. This is brought about in several ways. The simplest is to run the goods through cold water before soaping and can be done in the open width or in the first beck of the rope-soaper. Other commonly used methods are treatment with bichrome or chemic. The soaping then completes the oxidization.

In the oxidation by cold water it is essential that a copious supply of water be used and that a constant overflow be maintained. If this overflow is deficient, any undecomposed hydrosulphite tends to collect in the pit until a sufficient concentration is reached to react to some extent with the color, especially if the goods have been dyed with a direct dyestuff. Marking-

off and staining by washed-off color must also be guarded against.

In the soap becks a good quality of tallow or grease soap is used. In order to carry away dirt and excess coloring matter, a good head is kept on the soap, and the temperature kept at 150 deg. Fahr. or over. With these precautions, a clean, well oxidized print is assured. The necessity of thorough oxidation before finishing is illustrated by Indanthrene Yellow G. The oxidation of this dye is completed with more difficulty than that of most other vat colors, and even with an apparently thorough soaping, the print may tend to change shade after finishing and exposure to the atmosphere.

The rope-soaped cloth is now opened up and dried. To clean up the white in case of slight bleeding, chemicking may usually be resorted to, the strength of the solution being dependent on the ability of the color to withstand the treatment.

The goods are ready now for the usual operations of starching, tentering and calendering.

This paper has of necessity touched very briefly on the subject of printing, the details of processes and the difficulties encountered being many, and of interest only to those being engaged in the production of prints. If the general public were to spend some time in a print works, seeing the many operations and the difficulties arising, I believe that their respect for a piece of printed goods would be much increased.

## Discussion

*Mr. Hirst*—I would like to ask some man interested in woolen to give a description of the object and method of Vigoureux printing.

*Mr. Moran*—The Vigoureux printing is a very crude procedure by comparison with calico printing. It is merely a matter of printing lines across the slubbing as it goes through the machine, which is an intermediate part of the manufacturing of the wool. After the printing of these lines, they may be half an inch wide or three-quarters of an inch wide, and they will cover one-quarter, one-half, or one-third of the fiber—the wool proceeds to the later manufacturing operations and is drawn out so that the print is more or less uniformly distributed all through the yarn as it is spun afterward and gives you a thoroughly mixed result. When you come to spin and weave your threads into goods, and your goods are finished off you have got a uniformly mixed gray, or similar color. You can, of course, print it so as to cover a very large part of the wool, and in that case you will get a dark shade. If you print only a small part of it, one-fourth of your wool, you will get a much lighter shade. Usually you print a dark color in any case and get your shade by mixing larger or smaller quantities of white wool in with the printed part.

*Mr. Hirst*—That gives a different color, does it, from dyeing the wool an actual gray?

*Mr. Moran*—You can dye your wool on the top and mix it with white wool and draw it out in the drawing machinery so as to get the same general effect, but the results are not identical, as you do not get a uniform mixture when you dye in the top. When you dye in the top the wool fiber is dyed from one end to the other, and when you come to drawing that out you get streaky effects. When you print on Vigoureux and draw it out the printed part of the fiber is so mixed with the unprinted part that you get practically a uniform mixed effect all through the fabric.

*Mr. Hirst.*—What sort of a machine is that done on?

*Mr. Moran*—Why, it is a sort of a drawing frame, and at the end of it is a fluted roll and a color box; the fluted roll bears against another wooden cylinder roll covered with a woolen blanket which takes up the color; the fluted roll bears against the woolen blanket and picks up the color from the woolen blanket. The color is a great deal thinner than you use in calico printing and the fluted roll is usually made of wood, although it can be made of metal.

*The Chairman.*—There is one interesting feature of Mr. Hirst's paper, the samples he passed around. They give us an interesting idea of what happens in manufacturing processes. Probably that is one reason why people who own stock in manufacturing concerns do not get 75 per cent dividends; there are so many chances of making losses.

*Mr. Hirst*—The manufacturer who tries to give a material which is not perhaps as good a white but which is more durable suffers from the effect of this bichrome discharge, because if a woman buys a piece of goods printed with the bichrome and the spots drop into holes she will not buy any more Indigo. Consequently the man who prints the hydrosulphites loses his business; the Indigo business has dropped down considerably, perhaps not entirely for that reason, as women nowadays want pongees or sateens to wear around the house and will not buy cotton any more.

*Mr. Chapin*—Is that copper sulphate that you use?

*Mr. Hirst*—No; copper sulphide.

*Mr. Chapin*—It affects the doctor blade?

*Mr. Hirst*—It is easily seen that it does affect the doctor blade, but why should it affect it to-day and not affect it to-morrow?

*Mr. Claflin*—Possibly it is rust on your doctor blade.

*Mr. Hirst*—Well that rust ought to wear off when you grind it down for several hours.

*Mr. Moran*—I noticed you spoke of the Naphthol Red G. How about the Rapid Red G; do you consider the Naphthol Red G preferable to the Rapid Red?

*Mr. Hirst*—We have not had any practical experience with those Rapid fast colors. We have had laboratory

prints made and it seems to me that there is a future for them. They are reasonably good and fast, and if you can get the cost down I do not see why there is not a future for them, but how they will work in the printing machine we do not know. So with the new Indigosol. That is a good color and has a lot of advantages, but the cost is prohibitive at present when it comes to compete with the ordinary vat colors and Indigo, but now I believe the manufacturers are working on a complete list of shades. They are going to take those Indanthrene derivatives and treat them as the Indigosol; so we hope we will get a good line of vat colors for which we all pray.

*The Chairman*—Now that we are getting to prayers I move we adjourn.

*Mr. Cady*—I move a rising vote of thanks to both speakers.

. . . The question being taken, the motion was unanimously agreed to and the meeting adjourned. . . .

## JANUARY MEETING OF PHILADELPHIA SECTION

The regular January meeting of the Philadelphia Section of the American Association of Textile Chemists and Colorists was held in Philadelphia, January 8, 1925.

The meeting, preceded by the usual informal dinner at the City Club of Philadelphia, was called to order by the Chairman, Dr. Chas. Hollander, at 8.30 p. m. in the auditorium of the Philadelphia Textile School.

The minutes of the previous meeting were read and approved as read.

Dr. Hollander then reported briefly concerning the annual meeting of the Association in Philadelphia on December 5th and 6th, 1924.

There being no further reports of officers, the report of the Nominating Committee was received. Mr. Mullin, Chairman of this Committee, named the following as nominees for officers and Sectional Committee of the Section for the coming year (1925).

Chairman, Elmer C. Bertolet; Secretary, Percival Theel; Treasurer, Carl E. Medde. Sectional Committee —Dr. Chas. S. Hollander, Wm. J. Wall, Lawrence A. Stead, R. A. MacIntyre.

Further nominations from the floor were asked for and there being none, on motion of Mr. Mullin duly seconded the nominations were closed and the Secretary instructed to cast the ballot.

This being complied with the above were declared elected to serve as officers and Sectional Committee for the coming year.

Dr. Hollander, the retiring Chairman, then introduced to the Section the newly elected Chairman, Mr. Bertolet, who took charge of the meeting.

After a few brief remarks concerning the hopes for the Section during the coming year, the subject of having monthly or bimonthly meeting was discussed and referred to the officers and Sectional Committee for consideration. Mr. Bertolet then introduced the speaker of the evening, Albert P. Sachs of the Larvex Corporation of New York, who gave a most interesting and instructive talk on the subject of moth damage and moth prevention.

After a brief discussion of the paper, a motion by Dr. Hollander that a rising vote of thanks be extended the speaker was duly passed and followed by a motion of adjournment.

The meeting adjourned at 10 p. m.

There were about 30 present.

PERCIVAL THEEL, Secretary.

## Moth Damage and Moth Prevention*

By ALBERT P. SACHS

*Larvex Corporation*

In spite of the well-known methods of preventing moth attack and combating the ravages of this pest, moth damage has not been greatly diminished in recent years and there has seemed to be no chance of wiping out this source of loss. Before considering methods of prevention, it may be advisable to consider the life history and nature of the moth itself.

Moths and butterflies are the two great branches of a family of the insects well known to all of us. Butterflies have knobbed or clubbed antennae or feelers, while moths have all the shapes for their antennae except knobbed or clubbed. There are possibly 100,000 species of moths throughout the world and perhaps several tens of thousands of species in the United States. Some are ugly, some are beautiful, some fly by day and some are nocturnal in habit, some are harmful and some are useful.

Of all this great number, only three species attack wool or animal fibers. The common names of these three species are the case-making, the webbing and the tapestry moths. The last is rather uncommon but somewhat similar to the other two in appearance The first two are small buff colored retiring insects. They generally seek to run away and hide when discovered and display no great boldness. It is interesting to note, of these two species of moths, that their mouth parts are degenerated so that during their lifetime as adults in the flying stage, they do not eat at all and consequently can do no damage whatsoever under any conditions.

All moths have four stages in their life cycle. It is important to consider this life cycle because it has been found that in combating any insect pest, the life cycle must be thoroughly studied in order to determine at which point the repressive measures may best be undertaken. The four stages in the life cycle of the common

*Address (condensed) presented before the Philadelphia Section of the American Association of Textile Chemists and Colorists, January 8, 1925.

clothes moth are: 1, egg; 2, larva; 3, pupa; 4, adult winged insect.

The female lays her eggs, which generally number between 50 and 150, in the course of her short life of a week or two. She frequently begins laying on the first day on which she emerges from the pupa stage and continues laying practically until her death. Although a moth may live as much as a month, a life of one or two weeks is usual. The eggs are ellipsoidal and about one-fiftieth of an inch in length. It requires about a million to weigh an ounce. These eggs hatch in from four to seven days in summer and about two weeks in cooler weather, whereas cold weather prevents hatching until the temperature rises.

The little larvae or caterpillars, or worms, which hatch from these eggs are about one-thirtieth of an inch in length. They begin feeding immediately and as they eat they grow. Their food consists of all sorts of animal fibers, namely, wool, furs, feathers, hair and even untanned skins. The larva develops generally in about 15 to 20 weeks, during which time its weight multiplies by about 300. Of course, the actual amount of wool consumed, although large in proportion to the weight of the larvae, is comparatively small on the basis by which we are accustomed to judge weights. Unfortunately, the amount of damage in value far outweighs the amount of damage done by weight as an expensive garment may be completely destroyed by a small moth hole.

Although larvae generally develop into pupae in the course of fifteen to twenty weeks, cool weather or unfavorable circumstances, such as poor food supply, may delay this process and it may require two years, that is to say, the eggs laid by a moth may produce larvae which may still be doing damage two years later. The larvae, when they have reached their full growth, enter the pupal or cocoon stage. The larvae spin a very fine silk with which they line a little case into which they generally weave small fibers from the material on which they are feeding so that their cocoon is hardly distinguishable from that material. In this cocoon or pupal case the pupa gradually changes without any external motion or change in appearance, into the flying insect which is curiously packed away and folded together in this case.

Normally, fourteen to forty-four days are required to complete the development in the pupal stage. At the end of this time, the pupa bores its way from the case, the thin shell in which it is contained bursts and the full grown moth emerges ready to mate and lay eggs.

From what we have said, it is obvious that to attempt to kill the flying moth is likely to be ineffective. When we do kill it, it may have laid some or most of its eggs which are, of course, the only possible source of damage.

The great power of insects lies in their tremendous fertility. For instance, if we succeeded in killing all the house flies in the world except one pair, they could, in the course of one year, produce 400,000,000,000,000,000 descendants, which would be 7,000,000,000 for every square mile of the earth's land surface, or 250 for every square foot. Of course, insects have many natural enemies which feed on them and destroy them so that multiplication is never nearly so rapid as is possible, but at the same time complete extermination is similarly difficult. Possibilities of this kind actually do exist and are not mere theorizing as may be shown by the following instance:

Several decades ago an amateur naturalist at Cambridge, Mass. who was attempting to breed a hardy race of silk-producing moths, imported several cocoons of the Gypsy moth from Europe. This moth is not native to America and was not known here at all. Unfortunately, in his experiments with the moths which hatched from these cocoons, several escaped through an open window. From these has come the tremendous damage caused by Gypsy moths through the Eastern United States involving losses which have totaled probably hundreds of millions of dollars and necessitated costly preventive measures which have been only partially successful.

The figures given for the clothes moth indicate that it is not so prolific as the house fly, but the same type of danger of infestation from a few stray individuals always exists.

Moth repellents and preventives previously used have had, as their justification, the belief that the killing of the insect in its flying stage was of some importance. As a result, the various liquid petroleum derivatives were sprayed about containers, storerooms and other vessels, and garments were loaded with naphthalene, camphor or other odorous and offensive materials, and in general it was thought that by making certain places offensive to man they would be effectively protected against moths. This is not at all to indicate that preventive measures of the kind described have no value whatsoever, but their usefulness is strictly limited and may actually cause a great deal of harm through overconfidence in their value.

Cedar chests and mothproof bags are valuable only because they are tight containers. If goods or garments are free from moth life in any form when they are put into these containers, they will remain unharmed if the containers are tight, but if they contain larvae or eggs, or if the containers are not tight, damage may easily result, and I believe that it is fairly common experience that moth bags are of no great merit.

Naphthalene and camphor have also a very limited usefulness. Their vapors in high concentration are poisonous to moths and larvae. The high concentration required can be maintained only in tightly closed receptacles. An ordinary closet, a bureau drawer, or a trunk, is not a tight receptacle for these purposes, and it has been definitely proven that moth damage can occur in the presence of these or similar volatile odorous com-

pounds in such containers. However, in a good cedar chest or a tight factory storeroom, liberally treated with naphthalene (which means expensively), moth damage can be controlled or eliminated.

The use of hydrocyanic acid gas disinfection is effective in destroying not only moth life, but all other forms of useful and injurious life. The same thing applies to dry heat. Both these methods are effective and efficient, but there are certain difficulties in their application and their effectiveness ceases the moment the application is over. In other words, a garment treated with hydrocyanic acid gas may be completely sterilized, but five minutes after it is taken from the fumigation chamber, a moth may lay her eggs in the garment with impunity and the garment may become damaged.

This brings us to the truly important problem before us, namely, the permanent mothproofing of wool and animal fibers and fabrics. The specifications necessary for moth preventives are, first, that they have a certain amount of affinity for the fiber so that they remain more or less permanently attached. Secondly, that they be nonvolatile so that they may not lose in strength nor have an odor. Thirdly, they must be colorless so as not to affect the colors commonly used. Fourthly, they must be inexpensive and easy of application. In addition, certain other properties are desirable, as, for instance, that they be harmless to human beings and the higher animals, and that they be without effect on the feel of yarns or fabrics.

Naturally, attention was first directed toward discovering a compound similar to the commercial dyestuffs, but which was colorless and had the desired anti-larval properties, as our previous discussion clearly indicates that the measures must be directed against the larvae. Substances similar in chemical structure to the dyestuffs, but without tinctorial power are known, but have not been carefully studied because in dyestuff research, the substances produced having little or no tinctorial power have always been rejected as without value. Preliminary researches in this direction, owing to the difficulties involved, have not led to commercially valuable results. However, a fruitful field of research in this direction still remains open. It has been found that certain inorganic compounds can be applied in water solution to wool or other animal fibers under conditions in which they have a distinct affinity for the fiber. They render the material highly resistant to moth attack and generally fulfill the requirements previously indicated. The art is still in its early stages but development has been comparatively rapid so that it is now possible to apply these complex inorganic compounds to woolen fibers or fabrics on the industrial scale or in the home without any difficulty and at low cost. No change in the desirable properties of the yarn or fabric occurs.

The application of these compounds in mill practice has been very simply solved so that certain industries have availed themselves of this means of protection against moth damage very quickly. Others await the creation of popular demand for moth prevention. As an example of this, we may mention that the mohair upholstery fabric industry which seemed about to undergo decay because of popular fear that these beautiful and valuable fabrics were particularly susceptible to moth damage, has undertaken mothproofing with such successful results that the National Association of Upholstered Furniture Manufacturers have recommended that all fabric manufacturers mothproof all their mohair furniture fabrics.

For home application it was necessary to devise simple means for the use by the housewife. It is difficult, in the home, to immerse garments made up of several fabrics in aqueous solutions without doing damage. This method of immersion of garments is successfully carried out by dry cleaners who do wet scouring, but a certain amount of skill and the necessary facilities are required which are not available in the average home. The method of spraying was adopted. It became necessary to design and manufacture a suitable type of spray. The spray developed is very effective from a mechanical point of view. The protection provided, while not to be compared to that obtained by immersion, is still of sufficient value to completely justify its use.

In order to increase the effectiveness of spraying which was hampered by the well known fact that woolen and worsted fabrics are almost waterproof and will not easily be wet by any liquid sprayed on them, it became necessary to devise means of increasing the wetting power of mothproofing solutions. This increased wetting power, while useful even in factory operations, was not necessary there, but was found to be absolutely essential to making the household use properly effective. The desired result is obtained by the application of colloidal chemistry. It was found that the addition to the mothproofing solution of 0.01 to 0.05 per cent of certain colloidal substances increased the wetting power many fold. This can easily be shown by taking two small strips of the same fabric and immersing one into a beaker of ordinary mothproofing solution and another into a beaker containing the same mothproofing solution plus several hundredths of 1 per cent of colloid for about two seconds. Certain hard surfaced fabrics withdrawn from the mothproofing solution without the colloid will come out perfectly dry, having shed the liquid as they were withdrawn from the solution. A strip immersed under identical conditions in the solution containing the colloid will come out wet. The importance of this phenomenon for the proper application in the household of the mothproofing solution is quite evident. It was found necessary, in order to produce the proper stability of colloidal solution, to use two colloids, one of which was a protective colloid

for the other and prevented flocculation and precipitation of the colloid responsible for the increase in wetting power.

The direction of mothproofing research in the future will undoubtedly be toward the development of substances which have even greater affinity for the fiber and will consequently be absorbed by it to a greater extent, affording a larger margin of safety and possibly even more permanent mothproofing. It may also be a research along the line of producing organic compounds similar to dyestuffs, or, perhaps, substances of a totally new class may bring desirable results.

In reply to questions, it was brought out that the mothproofing compounds seem to act in either one or both of the following ways: Firstly, by causing the death of the very young larvae which are very sensitive to all sorts of environmental conditions, or, secondly, by being unpleasant or distasteful or inedible to the older larvae which cease to feed and either spin a cocoon of their own silk without damaging the fabric and die in it or produce weak underweight adult moths (a phenomenon noted by some of the audience in their own experience in testing the mothproofing agents).

It was also brought out that it is necessary to apply the mothproofing as the last wet operation in the plant and it is, therefore, carried out after dyeing and never during or before dyeing.

. . . In conclusion, it was mentioned that poets are frequently in advance of the scientists of their age and have, by a process of intuition, been able to arrive at conclusions which the scientists develop more slowly and painfully later. To bear out this point the speaker read the following poem by Arthur Guiterman in the Saturday Evening Post:

WARNING AGAINST MOTHS

These moths have most expensive tastes;
They dine on furs and velvet waists,
  They gnaw my evening trousers.
Though cotton does not please them much,
They dote on woolens—they are such
  Extravagant carousers!

By choice they make their cozy nests
In mothproof drawers and cedar chests;
  They thrive on naphtha vapor.
They lay their eggs in Paisley shawls,
They play croquet with camphor balls
  On sheets of tarry paper.

You see, I know their customs well;
For years I've kept a moth hotel
  And set a first-class table,
And never have I known a moth
To fail to pick the finest cloth
  That bore a tailor's label.

The moth is mighty hard to kill,
Though people try, as people will,
  To spank him while marauding;
For when we vainly clap our hands,
The stuck-up creature understands
  That everyone's applauding!

If anything that flies can beat
A moth in finding just the meat
  It wants, I haven't met it;
So if "the Moth desires the Star,"
They'd better wrap the star in tar—
  And then the moth will get it!

## Applicants for Membership

*Active Membership*

Boies, Orlow, chemist, du Pont Fibersilk Company, Old Hickory, Tenn. Sponsors: J. J. Sokolinski and J. E. Gardner.

Carter, W. B., dyestuff representative, Louisville, Ky. Sponsors: E. A. F. Zillessen and J. J. Sokolinski.

Homer, Maurice B., chemist, Chas. Enu Johnson & Co., Morton, Pa. Sponsors: B. K. Archer and Ed. S. Duhring.

Jansen, John W., consulting chemist, Passaic, N. J. Sponsors: E. A. F. Zillessen and E. J. Zillessen.

Korpanty, Edward J., manager Columbian Color & Chemical Company, Inc., Brooklyn, N. Y. Sponsors: W. W. Hales and L. S. Hirsch.

Meisenheimer, T. B., dyestuff salesman, Sandoz Chemical Works, Inc., Charlotte, N. C. Sponsors: J. E. Moore and C. H. Stone.

Moore, W. J., textile chemist, Pacific Mills, Lawrence, Mass. Sponsors: G. A. Moran and W. H. Cady.

Seydel, Herman, president and manager, Seydel Chemical Company, Jersey City, N. J. Sponsors: Martin L. Griffin and Walter S. Williams.

*Junior Membership*

Merriam, Paul A., plant manager, U. S. Finishing Company, Cedartown, Ga. Sponsors: L. L. Bamberger and T. Turner.

Sheffield, Isham, dyer, U. S. Finishing Company, Cedartown, Ga. Sponsors: L. L. Bamberger and T. Turner.

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AMERICAN
DYESTUFF REPORTER

Devoted to the use and application of dyestuffs and the mechanical equipment incidental thereto.

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Published biweekly by
HOWES PUBLISHING CO., INC.
90 William Street, New York City

A. P. HOWES, *President* E. S. PREDMORE, *Secretary*

Subscription price $5.00 per year; Canadian $5.50; foreign $6.00

Vol. XIV March 9, 1925 No. 4

## CHENEY ON FASTNESS GUARANTEES

A LETTER recently received from Frank D. Cheney, of Cheney Brothers, prompted by editorials on this subject previously published in The REPORTER, takes exception to the phraseology of part of our remarks. Mr. Cheney's comments, which are elucidating and amplifying rather than contradictory, are quite to the point and we agree heartily with all that he has to say. The greater part of his letter follows:

I should like, before proceeding with the discussion of the subject of ultimate responsibility for guaranteed fast dyes, to correct a statement in your editorial, which I think is misleading. The fourth paragraph of this editorial reads as follows:

"There is to-day no longer any question that practically all classes of fabrics can be dyed so as to be fast to any reasonable tests which they are likely to encounter in ordinary use. It is simply a question of the selection of proper dyes, and proper methods of application and the willingness of the consumer to pay the price necessitated by the use of these colors and processes."

While it is correct to say that practically all classes of fabrics can be dyed so as to be fast to reasonable tests, it is not equally true that all fabrics can be dyed in all colors fast to reasonable tests, which the uninitiated would infer to be the case from reading the paragraph in question. For example: cotton and silk yarn and fabrics can be dyed fast to washing or fast to sunlight in quite a wide variety of shades, but the more brilliant shades will be found to be missing from this line, and this paragraph should be clarified to this extent in order to express the whole truth.

In my opinion, it is not at the present time practical to require that a dyestuff manufacturer, who furnishes the colors to the textile manufacturer and who represents them to be fast, should assume responsibility for the ultimate fastness of the fabrics when delivered to the consumer unless the dyestuff manufacturer has guaranteed his dye to withstand certain fastness tests when used by the textile manufacturer under certain conditions to be prescribed by the dyestuff manufacturer. The dyestuff manufacturer would naturally have to judge each case on its own merits, taking into account the reliability and skill of the textile manufacturer, before assuming such responsibility. He should, however, in my opinion, be held responsible if the textile manufacturer can show that the dyestuff which he employed was of a type having a known fastness to light and washing, and that the particular shipment, upon which claim is to be made, did not equal in resistance the tests for the standard dye of its type.

The textile manufacturer or dyer is the only one who knows actually what materials and methods he has employed in turning out his product. He has had, or should have had, ample opportunity to test his product in order to determine its resistance to such tests as it may reasonably be expected to withstand, and he is not justified in guaranteeing fabrics as fast to light, washing or other agencies until he has satisfied himself that his fabric will fulfill the conditions of his guarantee. The failure to do this on the part of the manufacturer not only discredits his own product, but casts suspicion upon the guaranteed fabrics of other manufacturers, which shakes the confidence of the consumer in any manufacturer's guarantee.

In making the above statements, I do not mean to be understood as saying that a manufacturer should never guarantee an article until it could be made to withstand absolutely every test to which it might be put, because some consumers subject such articles to most unreasonable tests of wear and exposure, which it is not possible for any manufacturer to meet. Also, in considering this question, one should take into account the nature of the manufacturer's guarantee. For example: it will frequently be found that the most sun-fast dyes are not wash-fast and vice versa, and if a manufacturer is to produce curtain materials, he will naturally select the dyestuffs which are most fast to sunlight and will guarantee them fast to light, and it is not reasonable in such conditions to hold him responsible if the consumer has washed curtains which were not meant to be washed and has damaged the curtains by so doing, because the color ran in the washing. On the other hand, if the manufacturer's guarantee is that his fabrics are wash-fast, he will naturally direct his efforts toward making his line as wash-fast as possible, even at the sacrifice of some fastness to sunlight, and unless his product fades unreasonably fast when exposed to sunlight, the good faith of his guarantee should not be questioned,

provided the washfastness is as represented. Certain shades can be produced both wash-fast and sun-fast on certain fabrics, but as yet the dyestuff industry has not produced a complete line of dyes which will produce colors in all degrees of brightness and hue, and at the same time equal the resistance to both sunlight and washing, which will be found in the most wash-fast colors in the wash-fast group and in the most sun-fast colors in the sun-fast group.

In conclusion, I believe that the manufacturer should bear the final responsibility for the reliability of his guarantee, but he should not be held responsible for qualities of extreme fastness, which are not covered by his guarantee.

Very truly yours,

CHENEY BROTHERS,

(Signed) FRANK D. CHENEY.

## SILK WEIGHTING

IN a recent issue of the Dry Goods Economist there was published an open letter to silk manufacturers regarding the overweighting of silks. According to the author of this letter the practice has grown to an extent which seriously impairs the wearing qualities of the fabric and threatens the growth and prosperity of the silk manufacturing industry.

While it is quite possible that there may be certain cases wherein the weighting of silk has been carried to an extreme, it is the belief of The REPORTER that scientific weighting as carried on to-day by properly qualified silk processors enhances the beauty and improves the draping qualities of the fabric while at the same time actually increasing its durability.

Albert Blum of the United Piece Dye Works in the course of a letter written to Women's Wear on this subject says:

"This controversy (concerning silk weighting) has been beneficial in one way in that it has focused the attention of the silk merchants on the possibility of overweighting and improper weighting of silks. It is a highly technical problem, requiring skilled chemists experienced in the nature of silk and the problems of silk dyeing, and it should never be done merely to increase the apparent weight of the silk or to produce a wrong impression as to the amount of silk used in any fabric."

In the above paragraph Mr. Blum has stated the case most clearly. Weighting should never be resorted to solely as a means of increasing the weight of the fabric, but as a reinforcement of the fiber it has manifest advantages which any chemist will appreciate.

Whereas the old method of finishing silk consisted of a sort of plating process wherein gums and other finishes were spread on the piece and forced into the weave under hot calenders, the modern, scientific method of weighting causes the fiber itself to absorb the weighting agent in such a way that it becomes an integral part of the cellular structure of the silk fiber. This process endows the finished fabric with luster and draping qualities which would otherwise be impossible of attainment.

There is no doubt that textile chemists and other technically trained men who have had experience in the processing of silk realize to the full the advantages to be gained by scientific weighting and appreciate the necessity of such treatment if American made fabrics are to compete successfully with those produced abroad. Unfortunately, however, the layman does not and cannot be expected to appreciate the technical aspects of the weighting operation. He is altogether too prone to seize upon the word "weighted" as an admission of adulteration. All textile chemists and others who are in a position to speak with authority should seize every opportunity offered to impress upon laymen and particularly retailers and garment manufacturers that scientifically weighted silk is a superior and not an inferior product.

## CORRESPONDENCE

The following letters passing between Carl E. Bick, of the Real Silk Hosiery Mills, and E. H. Killheffer, of the Newport Chemical Works, are reprinted with the writers' permission. They concern the much-discussed question of responsibility for fastness guarantees, and were stimulated by the original editorial on this subject published in The REPORTER. The letters follow:

REAL SILK HOSIERY MILLS
INDIANAPOLIS, IND.

February 17, 1925.

MR. ELVIN H. KILLHEFFER, Vice-Pres.,
Newport Chemical Works, Inc.,
Passaic, N. J.

DEAR SIR: Your comment on fast dyes as published in the February 9 issue of the AMERICAN DYESTUFF REPORTER has been brought to the writer's attention.

The general buying public, it is true, is demanding better and faster colors. It is up to the manufacturer to meet the demands of his customers, so he guarantees his merchandise against reasonable conditions. The manufacturer alone is held responsible and the only chance he has to meet competition is to give his customers whatever they want by the aid of his own technical staff and that of the chemical manufacturers.

To shift the blame entirely upon the textile manufacturer is not quite fair. His dyeing problems are and always should be of interest to the dyestuff manufacturer, and if a dyestuff house does not know how its products are being applied, its staff of technical men either lack interest or else are not on the job.

It is obvious that there are many different methods of application of a dyestuff. Just because a dyer does not proceed on a practical scale in the manner outlined by a laboratory should not influence the dyestuff manufacturer to let the dyer paddle his own canoe if better results can

be obtained. Many times methods of application on a practical scale depend upon the nature of the material to be dyed. Fast results may be desired, but the material itself might not stand the chemical or mechanical action necessary to produce a color by means of certain set rules.

In cases like these the dyestuff manufacturer is concerned, and there certainly is no excuse for him not knowing how his products are applied. Every manufacturer is anxious to improve his product, and co-operation on the part of the chemical industry is welcomed by all of them.

Very truly yours,
(Signed) CARL E. BICK.

* * * *

NEWPORT CHEMICAL WORKS, INC.
PASSAIC, N. J.

MR. CARL E. BICK, February 24, 1925.
Real Silk Hosiery Mills,
Indianapolis, Ind.

DEAR MR. BICK: I was very much interested indeed to receive your letter of the 17th commenting on the one I had written to the AMERICAN DYESTUFF REPORTER.

I do not think that we are really in disagreement anywhere, because, as a matter of actual fact, I did not shift any blame anywhere. The question that had originally been raised, as you will recall, by the editor of that magazine was how responsibility could be fixed for fastness or the lack of it in dyed materials purchased by the public. Now, as I read your letter you agree with me that the textile manufacturers do, as a matter of actual fact, shoulder the responsibility. Personally I cannot very well see how that can be avoided or even how the responsibility can be shared.

This most certainly does not mean that the dyeing problems of the textile manufacturer are not of interest to the dyestuff manufacturer, because they are at all times of very great interest; and, furthermore, as I said in my former letter, the dyestuff manufacturers are only too glad to be of any possible assistance at any time.

I think the greatest difference in our views at the present time is in connection with what the dyestuff manufacturer should know regarding how his products are being applied, because in connection with this you say that if the dyestuff manufacturer does not know, then either his technical men lack interest or are not on the job. When you make this statement, however, you overlook the fact that a very large percentage of textile manufacturers do not look at the proposition in the broad way that you do. What I mean to say is this: You personally recognize that the dyestuff manufacturer's technical men can at times be of some assistance or make good suggestions, and it is only in cases like yours, where problems are approached in this way, that the dyestuff manufacturer's technical men get an opportunity to be of service, whereas in the large percentage of cases before mentioned the advice or help of the dyestuff manufacturer's technical men is neither sought for nor desired. I believe this condition is improving, but it certainly has not progressed to any such point where the supplier of dyes could in fairness to himself extend any guarantees.

If I have not made myself entirely clear, or if there are still points on which we disagree, I would certainly be glad to hear from you further. Have you any objection if I send your letter and my reply to the editor of the AMERICAN DYESTUFF REPORTER for publication along with other comments he may have?

Yours very truly,
(Signed) ELVIN H. KILLHEFFER,
Vice-President.

* * * *

REAL SILK HOSIERY MILLS
INDIANAPOLIS, IND.

March 2, 1925.

MR. ELVIN H. KILLHEFFER, Vice-Pres.,
Newport Chemical Works, Inc.,
Passaic, N. J.

DEAR MR. KILLHEFFER: In reply to your letter of the 24th ult., in which you discuss the co-operation between textile mills and dyestuff houses, please note that the doors of the Real Silk Hosiery Mills are always open to representatives of all dyestuff and chemical houses. We realize the importance of the chemical industry as applied to our business, and do at all times solicit your valued suggestions, which, we assure you, shall all receive our attention, and if desired can be tried out on a practical scale in our plant under your supervision.

We are always anxious to improve our product, and we hope that our co-operation with the chemical industry is a step forward in giving the ultimate consumer better merchandise.

At your suggestion it will be satisfactory to publish my letter and your reply in the AMERICAN DYESTUFF REPORTER.

Very truly yours,
REAL SILK HOSIERY MILLS,
(Signed) CARL E. BICK.

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## MOTH LARVAE WANTED

The laboratory of the Lowell Textile School experiences considerable difficulty in securing active larvae for experimental purposes in connection with moth preventives. It is possible that some of the readers of The REPORTER may have in their possession some highly infested material of this character. In case they have and it shows a goodly number of the live larvae it would be of considerable value for the promotion of this work; and if they care to do so we should be pleased to have them send it, care of Professor L. A. Olney, to the Lowell Textile School, Lowell, Mass.

# Dyestuff Tables

## A List of the Principal American-Made Colors with Their Properties and Fastness Characteristics

[NOTE: The publishers of The REPORTER have secured more or less complete data in regard to many of the dyestuffs which are at the present time being manufactured in the United States. As the following material has been brought together from various sources, they realize that errors are quite likely to appear, and it is earnestly requested that any readers who find errors or who are able to give additional information will communicate with the publishers in order that this material may be made as correct, complete and up to date as possible. These tables will appear serially until all colors upon which we have data shall have been covered. The publication of this data was begun in the issue of March 10, 1924.]

### BENZO ORANGE R

**(Schultz No. 340)**

**COMPOSITION:** Disazo.

**SPECIALLY SUITABLE FOR:** Cotton.

**USUAL METHOD OF DYEING:** With common salt and soda ash. Use very little alkali. Shade must be well rinsed.

**SHADE:** Reddish orange.

**SHADE BY GASLIGHT:** Redder.

**SOLUBILITY:** Poor.

**LEVEL:** Does not level well.

**EXHAUSTS:** Well.

**FASTNESS TO:**

**Acid:** Very sensitive.
**Alkali:** Fairly fast.
**Chlorine:** Color destroyed.
**Cross-Dyeing:** Will not stand cross-dyeing.
**Ironing:** Fair.
**Light:** Fugitive.
**Mercerizing:** Poor; will not stand mercerizing.
**Perspiration:** Fair.
**Rubbing:** Fast.
**Scouring:** Very moderate; bleeds off badly.
**Washing:** Bleeds badly.
**Water:** Will not stand water; bleeds in cold water.

**SENSITIVE TO METALS, LIME:** Sensitive to iron; not sensitive to copper.

**OTHER PROPERTIES:** Not suitable for after-treating with copper or chrome. Not suitable for pad dyeing.

**DYED BY OTHER METHODS:** Dyed on goods containing artificial silk (Lustron), the effect threads are left white in a neutral bath.

**ON UNIONS:** Cotton-wool unions: Both fibers dyed the same depth. Cotton-silk unions: Both fibers dyed the same depth.

**ON OTHER MATERIALS:** Artificial silk: Suitable dyed at 160 deg. Fahr., not fast on this fiber. Silk: Fairly fast to water; not fast to soap. Wool: Dyes chrome-mordanted wool orange. Paper: Suitable. Leather: Suitable.

**PRINTING:** Not adapted.

**DISCHARGING:** Discharges white with sulphoxalates.

**COMPETING PRODUCTS:** Made in the United States by Cincinnati Chemical Works; E. I. du Pont de Nemours & Co.; Grasselli Chemical Company; Newport Chemical Works, Inc.; Commonwealth Color & Chemical Company; American Aniline Products, Inc.

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### CHRYSAMINE G

**(Schultz No. 342)**

**COMPOSITION:** Disazo.

**SPECIALLY SUITABLE FOR:** Cotton.

**USUAL METHOD OF DYEING:** Dyed direct in a soap bath with phosphate of soda.

**SHADE:** Reddish shade of yellow.

**SOLUBILITY:** Not good with hard water.

**LEVEL:** Dyes level.

**FASTNESS TO:**

**Acid:** Not fast, except against dilute organic acids.
**Alkali:** Not fast; shade goes redder.
**Chlorine:** Destroyed.
**Light:** Excellent for a benzidine derivative.
**Scouring:** Will not stand soap.
**Washing:** Bleeds off badly.

**DYED BY OTHER METHODS:** After-treatment with copper makes the shade much duller but faster to light.

**ON UNIONS:** Not suitable.

**ON OTHER MATERIALS:** Not suitable.

**DISCHARGING:** Discharges a cream shade with hydrosulphite.

**COMPETING PRODUCTS:** Made in the United States by American Aniline Products, Inc.; Cincinnati Chemical Works; Consolidated Color & Chemical Company; E. I. du Pont de Nemours & Co.; National Aniline & Chemical Company; Newport Chemical Works, Inc.

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### DIAMINE FAST RED F

**(Schultz No. 343)**

**COMPOSITION:** Disazo.

**SPECIALLY SUITABLE FOR:** Cotton and wool.

**USUAL METHOD OF DYEING:** On cotton: Dye with salt at the boil; add soda or soap for light shades. The addition of sodium thiosulphate on dark shades makes them fuller. On wool: Dye with Glauber salt and top-chrome.

**SHADE:** Dull red.

**SHADE BY GASLIGHT:** No change.

**SOLUBILITY:** Fair.

**LEVEL:** Dyes level on cotton; does not dye level on wool.

**EXHAUSTS:** Quickly.

**FASTNESS TO (on Cotton):**

**Acid:** Fast against acetic.
**Alkali:** Fast.
**Chlorine:** Moderate; shade destroyed.
**Cross-Dyeing:** Will not stand cross-dyeing.
**Ironing:** Shade hardly changes.
**Light:** Relatively good.
**Perspiration:** Fast.
**Rubbing:** Fast.
**Steaming:** Fast.
**Sulphur:** Fast.
**Washing:** Bleeds badly.
**Water:** Bleeds badly in water at 104 deg. Fahr.

**DYED BY OTHER METHODS:** On cotton: If after-chromed and coppered, is faster to washing but the shade is duller and yellower. Topped with 3 per cent fluoride of chrome and 3 per cent acetic acid at the boil, the color is very fast to washing.

**ON UNIONS:** Cotton-wool unions: Both fibers the same shade.

**ON OTHER MATERIALS:** Wool can be dyed top chrome, chrome mordant or chromate. The color is very fast to fulling, stoving, washing, steaming, cross-dyeing, acids and light, though it crocks slightly. Dyed direct, it stains the cotton in fulling but leaves the wool white. Top-chromed, the cotton is stained less. Cotton-silk unions: Covers cotton well. Dyed at 100 deg. Fahr. with soap, the silk is left white.

**PRINTING:** Printed on gloria, suitable. On cotton-silk unions, suitable.

**COMPETING PRODUCTS:** Made in the United States by American Aniline Products, Inc.; Butterworth-Judson Corporation; Central Dyestuff & Chemical Company; Cincinnati Chemical Works; E. I. du Pont de Nemours & Co.; Essex Aniline Works (Selling Agents, Grasselli Dyestuff Corporation); National Aniline & Chemical Company; Newport Chemical Works; Noil Chemical & Color Works; Palatine Color & Chemical Company (Selling Agents, F. E. Atteaux & Co.).

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## DIAMINE BROWN

**(Schultz No. 344)**

**COMPOSITION:** Disazo.

**SPECIALLY SUITABLE FOR:** Cotton.

**USUAL METHOD OF DYEING:** With common salt.

**SHADE:** Violet shade of brown.

**SHADE BY GASLIGHT:** Reddish.

**SOLUBILITY:** Good.

**LEVEL:** Does not dye level.

**EXHAUSTS:** Well.

**FASTNESS TO:**

**Acid:** Concentrated acid turns it somewhat redder.
**Alkali:** Shade does not alter with 20 per cent ammonia.
**Boiling:** All the after-treated shades are fast.
**Chlorine:** Not suitable.
**Fulling:** Moderate; stains white.
**Ironing:** Shade goes temporarily redder.
**Light:** Moderate.
**Rubbing:** Fast.
**Scouring:** Moderate; scours off.
**Sulphur:** Shade changes and bleeds.
**Washing:** Fairly fast; bleeds somewhat.

**MACHINE DYEING:** Not suitable for padding.

**DYED BY OTHER METHODS:** Coppered and chromed, faster to washing. Coppered alone, faster to washing; moderately fast to fulling. On wool, dyed chromate O. K.

**ON UNIONS:** Cotton-wool unions: Wool is darker than the cotton. After coppered and chromed, suitable for shoddy unions and stands fulling against white wool.

**ON OTHER MATERIALS:** Silk: Dyed a bright Bordeaux in an acetic acid and Glauber salt bath: Wool: Color gives a Bordeaux-brown shade. Dyed chromate O. K. Jute: A dark maroon shade is produced. Cotton-silk unions: The cotton is much bluer than the silk Dyed with salt at the boil, the silk is nearly white.

**REMARKS:** After-treatment and development: After-treated with chrome, dull violet; with copper, redder than direct dyeing; with chrome and copper, chocolate brown. Dyed and developed with beta-naphthol, violet brown; with phenol, red brown; goes lighter on cross-dye; with paranitraniline, coffee brown; with Developer H, blackish violet brown.

**COMPETING PRODUCTS:** Made in the United States by Amalgamated Dyestuff & Chemical Works (Selling Agents, John Campbell & Co.); American Aniline Products, Inc.; Butterworth-Judson Corporation; Central Dyestuff & Chemical Company; Cincinnati Chemical Works; E. I. du Pont de Nemours & Co.; Essex Aniline Works (Selling Agents, Grasselli Dyestuff Corporation); National Aniline & Chemical Company; Newport Chemical Works; Noil Chemical & Color Works; Commonwealth Color & Chemical Company; Palatine Color & Chemical Company (Selling Agents, F. E. Atteaux & Co.).

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## CRESOTINE YELLOW

**(Schultz No. 351)**

**COMPOSITION:** Disazo.

**SPECIALLY SUITABLE FOR:** Cotton.

**USUAL METHOD OF DYEING:** Dyes cotton direct from a common salt bath.

**SHADE:** Dull shade of yellow.

**FASTNESS TO:**

**Acid:** Will not stand acid.
**Alkali:** Will not stand alkali.
**Chlorine:** Chlorine destroys color.
**Light:** Fugitive.

*(Continued on page 171)*

# Iron and Chromium on Cotton or Wool

**Prussian Blue—Mordant for Blues—Chromium—Basic Chromates**

**By W. B. NELSON**

[EDITOR'S NOTE.—*This is fourth in a series of articles dealing with the vegetable dyestuffs used in dyeing textiles. The author is an experienced dyer and colorist of "the old school," and his writings will no doubt prove of interest to those who are still using the older natural dyes.*]

THERE are numberless preparations sold in the open markets of the world under the name of nitrate of iron. These include the real nitrate of iron and various mixtures of nitrate and sulphate and acetate of iron. The iron itself is sometimes entirely in the ferric form; sometimes partly in the ferric and partly in the ferrous condition.

The different iron mordants fluctuate in specific gravity from 1.25 to 1.62. It is quite essential that we have these different forms, for the salt is to be chosen for a specific purpose, and in some cases we want a ferric and in some cases a ferrous mordant. For this reason it will be as well for us to give a short description of each iron salt found in the market and the uses to which it may be put.

Ferric Nitrate, $Fe_2(NO_3)_6$.—This ferric nitrate is prepared by dissolving iron in nitric acid. It is largely used in dyeing iron buff and Prussian blue, and is prepared as follows: This is a persalt of iron and to-day is not generally used in the dyehouse. It is made by putting clean iron into dilute nitric acid in which it quickly dissolves. It is customary to add the iron so long as the acid dissolves it, and it must be added slowly and cautiously or it will boil over.

Nitrate of iron itself dyes a buff or nankeen color, and this alone is probably the easiest color to dye of all the colors, and is, perhaps, among the mineral colors also the fastest. Good shades are obtained if the goods are first impregnated with a solution of above at 2 to 6 deg. Tw. in the padder or water mangle; the pieces are given two or three passages and are afterward washed. The passage through an alkaline bath is not necessary. The depth of the shade depends entirely on the amount of ferric hydroxide precipitated on the fiber from a light yellow to a light brown. Iron buff is quite fast to soap, light and alkalies but is stripped by acids.

## PRUSSIAN BLUE

Prussian blue is largely used to-day on wool, but on cotton it has been largely replaced by the basic cotton dyestuffs. One of the simplest ways of dyeing Prussian blue consists in first dyeing the cloth iron buff. The color is then developed through a cold solution of potassium ferrocyanide (2 parts) which has been acidified with sulphuric acid, 168 deg. Fahr. (1 part). The general properties of Prussian blue on wool, its excellent fastness to light and acids and its greatly inferior fastness to milling, alkali and soaping, are within the knowledge of every dyer. It is not generally known, however, that its fastness to alkalies is greater when dyed on wool than on cotton. It is further known that an equal weight of red prussiate dyes a very much fuller shade than the yellow prussiate. It is much more expensive, however, to use the red prussiate, and therefore the yellow prussiate is usually used. It has been found that the yellow prussiate can be used by converting it into the red prussiate in the bath. At first this process was a failure, and it was found that chlorination of the wool was needed. This was out of the question with some fabrics, and so it was found eventually, that the best method was to add sodium hypochlorite to the cold acidified dye bath containing yellow prussiate and sulphuric acid. It is usually worked in this way: Hypochlorite is added until the smell of chemic is observed, the hypochlorite added slowly and gradually; the smell is then removed by adding a small portion of bisulphite; wool is entered in the usual way and the dyeing proceeds in the regular manner by raising to the boil in half an hour and boiling one hour. The shade is developed earlier and more gradually than it is with the regular yellow prussiate and the resulting shade is much heavier.

An excess of bisulphite appears rather to brighten the shade; at least it does not appear to have any detrimental action. The wool is quite unaffected by any such use of the hypochlorite. An excellent royal blue can be produced with about 5 per cent of the yellow prussiate. This is produced at a much lower cost than with either red prussiate or a larger amount of yellow prussiate than is ordinarily used. The shade is not, in any way, inferior and it must be understood that if a bath is prepared on these lines it is a complete substitute for red prussiate.

Prussian blue is not always fast to rubbing, but one-half per cent of bichrome improves the fastness but makes it duller and greener. Salts and acid brighten these colors, and a bottom of sumac adds to their depth and weight, but also adds to their harshness.

It may be stated that the method of converting yellow prussiate into red prussiate while making up the dye bath for wool has its parallel for producing Prussian blue upon cotton. This also increases the dyeing strength of the bath. A blue that is fast to rubbing on tannin mordanted cotton is produced as follows: A 5 per cent solution of yellow prussiate with 2 per cent of sulphuric acid is added to the bath, *cold*. To this solution is added sodium hypochlorite cautiously until a drop of the liquor when tested with chlorite of iron gives no longer a blue precipitate. When this state is arrived at it is quite within the possi-

bilities of adding an extra 2 per cent of chloride of iron; after which the sulphuric acid should be just neutralized, the solution remaining clear. The tannin mordanted cotton is then dyed as described before.

It is quite impossible to give quantities, especially of hypochlorites, as this product varies in strength, alkalinity and local conditions, as do the other dyestuffs.

If tannin has been used, fixed with iron, instead of antimony, a dull, blue shade is produced which may be brightened by souring with hydrochloric acid.

Ferric Sulphate (Nitrate of Iron), $Fe_2(SO_4)_3$.—Nitrate of iron consists chiefly of ferric sulphate. Some of the commercial products probably correspond to the formula $Fe_4(SO_4)_5(OH)_2$. It is prepared by treating copperas with nitric and sulphuric acids.

### Mordant for Blues

A mordant for blues on silk or cotton which stands at 77 deg. Tw. is made as follows: 200 pounds copperas in 25 gallons of hot water; when all is dissolved add 200 pounds nitric acid at 67 deg. Tw. and boil up again; shut off steam and allow to cool to about 100 deg. Cent., and then add cautiously about 40 pounds of scrap iron, broken small. The scrap must be added slowly as the action upon it develops considerable heat and if the temperature gets too high the liquor will spoil and the whole bath will turn gelatinous. After the reaction is over dilute it with cold water and bring the whole mass to 77 deg. Tw., which should give a clear, dark brown liquid.

The common iron liquor of commerce stands at about 100 deg. Tw. and is made as follows: 300 pounds nitric acid, 150 pounds sulphuric acid (double), 40 pounds scrap iron and boiling water until the acids will dissolve no more. Then heat up by steam coil and add gradually 680 pounds copperas. The resulting clear liquor is the nitrate of iron of commerce.

Sodium Nitrate Liquor.—Dissolve in hot water 60 pounds sodium nitrate in 17 gallons of water. When dissolved add 50 pounds double oil of vitriol and as much scrap iron as will completely dissolve. This is highly praised for all classes of blues, but is unstable and not to be recommended unless used at once.

We might say here that the sulphuric acid or oil of vitriol are $H_2SO_4$ and that the weakest sulphuric acid is the so-called *chamber acid* which has a specific gravity of 1.50 to 1.60, while the acid known as *brown oil of vitriol* (B. O. V.) has a specific gravity of 1.70. The concentrated acid known in commerce as *oil of vitriol* (O. V.), or *double oil of vitriol* (D. O. V.), is obtained by further concentration of the B. O. V. The acid must be mixed carefully with water, the water must be cold and the acid must be allowed to run in a thin stream into it with continuous stirring.

We have seen that under the name of "nitrate" an innumerable quantity of preparations are sold, some of which are made up of nothing but nitric acid and iron which should be used especially for Prussian blues. There are others which contain mixtures of nitric, sulphuric and acetic for drabs, modes, etc.; others contain nitric and sulphuric acids in varying proportions. Some of them are perfect persalts of iron; such are Prussian blues, and others, but most of them contain protosalts to a greater or lesser degree. Some are prepared from commercial nitric acid, and again others are made from nitrate of soda and sulphuric acid. Some are made from scrap iron, some from copperas, and some from a mixture of the two.

Blue irons for dyeing Prussian blue should be acid, but not too acid, and should be a true persalt. Black irons should be both persalt and protosalt and strictly neutral. The common saddening nitrate of iron should be a mixture of the two. A preparation of iron largely used at some works is the common acid nitrate (neutral) with free acetic acid. This is usually accomplished by adding a little acetate of lead to the solution of nitrate of iron. The acetate of lead is decomposed by any free sulphuric acid that may be present with the formation of an insoluble sulphate or nitrate of lead and free acetic acid.

We should have said that if a ferric nitrate is used for an iron buff made from any of the above materials, except the real nitric acid and iron scraps, a solution of soda standing at 1 to 3 deg. Tw. should be used as the last bath. This completes the oxidation of any ferrous salt that may remain.

Ferrous Acetate, Iron Liquor, Black Liquor or Pyrolignite of Iron, $Fe(C_2H_3O_2)_2 + 4H_2O$.—Ferrous acetate is prepared by dissolving iron in pyroligneous acid, or, by double decomposition of ferrous sulphate and crude calcium acetate. Its principal impurities are ferric sulphate and excess of acetic acid and it is used largely as a mordant for Alizarine colors, for black dyeing with logwood and in the production of iron buffs and khaki shades and for prints.

Acetic acid, or vinegar, acts readily on iron, dissolving it and forming the acetate, which crystallizes in small green crystals very rapidly acted upon by the air. This very important mordant consists of protoxide of iron almost entirely, and is much used in the dyehouse where it is known as iron liquor. This acetate of iron may also be prepared by mixing together protosulphate of iron and acetate of lime (gray). The sulphate of lime is precipitated and falls to the bottom and the acetate of iron remains in the solution. The crude pyrolignite of iron is preferable in every way. It is found that the purified acid produces a less satisfactory liquor, a fact due, according to Moyret, to the presence of a small quantity of pyrocatechol in the crude acid, which forms a compound with the ferrosoferric oxide in the solution, and causes its intense color and keeping properties.

The liquor used by dyers is often concentrated, not by evaporation, but by the addition of copperas (ferrous sulphate); thus, the addition to one gallon of black liquor, spr. gr. 1.085, of one-half pound of copperas would raise its density to 1.111. Over one pound of copperas has been found in one gallon of iron liquor. Tannin is

sometimes added. Black liquor is sometimes also prepared by the action of ferrous sulphate or acetate of lime; the liquor produced has an average density of 1.11 and always contains *sulphate of lime*.

Black or iron liquor is sold at different strengths, ranging from 10 deg. to near 30 deg. Tw. It has an astringent taste, and is of an olive color, but in large quantities it appears black. It serves for producing upon cotton a variety of shades according to its strength and the coloring matter with which it is used. It gives its oxide of iron to the fiber more readily than copperas.

To find if black iron is genuine add a little nitric acid and apply heat to oxidize the iron. Then add excesses of ammonia, and filter off the precipitate. The clear liquid remaining is evaporated to dryness and the residue heated strongly. Nothing should remain but a trace of tarry matter derived from carbon. If common salt has been added to raise the Tw. it will be found as a white mass.

As a mordant for print works (also for dyeworks) where a fast black is called for, the mixture of scrap iron (preferably old hoops, etc.) and pyroligneous acid is always (or nearly so) preferred to any purer article prepared from acetate of lead, or acetate of lime and copperas, probably because the peroxidization of the protoxide of iron by exposure to the air during the aging of the goods is retarded by certain impurities present, which have a stronger affinity for the oxygen of the air. A small quantity of the acetate of the peroxide of iron is sometimes contained in iron liquor, but it is by no means as an essential constituent.

The reader will find that two oxides of iron are described or spoken of—the peroxide and the protoxide. He will also find that both of these oxides combine with acids to form salts, but that the protoxide and protosalts may be readily converted into the peroxide and persalts. Both of these salts may be used as mordants, but the protosalts are best for vegetable substances. It is, therefore, a matter of much importance to preserve the iron in a state of oxidation until it be immersed in the dye bath; this is effected in many instances by astringent substances. For example, in the detailed process of dyeing black by means of iron and logwood, the goods are steeped in sumac, and then put through lime water. This turns the sumac on the cloth green, and converts some of its constituents into a state well fitted to combine with oxygen, which it will take from the atmosphere if exposed to it, thereby losing its green color and resuming the color it had when taken from the sumac. When the cloth is a deep green it will combine rapidly with the protosalts of iron, such as copperas, and give a black color, but if a persalt of iron be used, the resulting color is a gray state. The former becomes darker as it stands, the latter grayer.

If we now take the goods rendered black by a protosalt and put them through lime water they are converted into a rich brown from the peroxidizing of the iron, but if allowed to stand exposed to the air for a short time they assume their black color again. If the goods are put into the logwood when they are of this brown color, the black is seldom good. They should always be allowed to assume the black hue before being immersed in the logwood bath. For this reason we have always preferred washing them from the copperas rather than putting them through lime water. It must always be remembered that the iron in black iron gives the best results for blacks, at least, if the iron is in a state of oxidation intermediate between ferrous and ferric iron; also that iron and oxygen always combine in four proportions with oxygen as follows:

| Compounds with oxygen | Formula | Iron % | Oxygen % |
|---|---|---|---|
| Ferrous oxide (protoxide). | Fe O | 77.77 | 22.23 |
| Ferric oxide (sesquioxide). | $Fe_2O_3$ | 70.00 | 30.00 |
| Ferrosoferric (magnetic oxide) ..... | $Fe_3O_4$ | 72.41 | 27.59 |
| Ferric acid ..... | $Fe\ O_3$ | 53.80 | 46.50 |

In dyeing khaki the goods are given two passages through a padding machine through a mixture of ferrous and chromic acetates; the strength of the two, i. e., the acetate of chrome and the acetate of iron is about 36 Tw. The cloth is now dried on wrapped cans and afterward steamed in a rapid ager where the steam and air are maintained at about 220 deg. Fahr. The goods are then passed through a boiling solution of caustic soda and sodium carbonate at 12 deg. Tw. The proportion of caustic soda to sodium carbonate in the fixing bath is 1:3. The goods are washed off in lactic acid and dried.

The black iron is used for both printing and dyeing fast black and also for dyeing and printing many of the Alizarine dyestuffs; or, mixture of this iron and alumina mordant is used, for instance, violet and Bordeaux shades are produced by dyeing with Alizarine dyestuffs on an iron mordant.

Ferrous Sulphate, Copperas or Green Vitriol, $FeSO_4 + 7H_2O$.—The impurities usually found are copper, alumina, zinc and free acid. Ferrous sulphate is readily soluble in water and is used as a reducing agent in indigo dyeing, in the dyeing of grays and blacks, in the fixing of tannin mordants and for the production of various iron mordants. In indigo dyeing it is used both for artificial and real indigo, and the vats made this way always contain a large amount of sediment; it is therefore used largely for dyeing yarns. In fact, while all the cold vats are largely used for cotton dyeing, the copperas vat is mainly used for yarns, and a certain amount of indigo is nearly always lost in the vat due to the formation of products other than indigo white. Great care must, therefore, be shown to conduct all cold vats so as to reduce this loss to a minimum. It has been calculated that the copperas vat loses 25 per cent for indigo; the zinc lime vat 10 per cent, and the hydrosulphite vat 2 per cent. For wool dyeing a warm or fermentation vat is used. There is always one thing to be said in favor of a copperas vat and that is that it is both easily set and kept in condition. The excess of lime present in the vat dissolves the indigo white and it does

not do to keep the temperature of the dyehouse too low in winter.

It is essential that the indigo be well ground with water, or, if paste is used (B. A. or M. L.), it should be mixed with water. It is then customary to take the lime, made into a thin uniform paste with water, add a little warm water and then the indigo (as above) is stirred into it. The copperas is then dissolved in hot water and the solution of copperas is (without continuous stirring) added slowly to the indigo paste. The whole is poured into a tank filled up with warm water and allowed to stand (with occasionally stirring) 5 or 6 hours until cool. This stock vat is ready as soon as it has a clear yellow shade. In the meantime, the dye vats have been partly filled with water and the stock vat is now added to this, and after the liquor has been well stirred for some time it is allowed to settle. The boiled yarn should be hydroextracted and well wrung and shaken before dyeing; the yarn is soured and well washed and rinsed in a 1 or 2 per cent of sulphuric or hydrochloric acid after dyeing.

Before pouring the vat dyestuff into the dye vat, 1 pound of copperas and 2 pounds of quicklime per 100 gallons of liquor should be added. It may be as well to say here that:

Hummel says: Twenty pounds natural Indigo, 25 to 50 quicklime, 30 to 40 copperas, 400 gallons.

B. A. says: Thirty pounds Indigo paste, 20 per cent; 36 pounds quicklime, 24 pounds copperas, 60 gallons water (strong stock vat). Both are pretty nearly right.

A very common impurity in copperas is sulphate of alumina. The deleterious nature of this salt does not exist in its action upon the Indigo, but it introduces to the vat a good deal of sulphuric acid; and as it forms a double salt with the sulphate of iron—which double salt combines with 24 equivalents of water—its presence may account for the various results obtained by experiments with bad copperas and its effects on the vat. It is no doubt the presence of this sulphate of alumina which renders this copperas so inferior to others. The presence of this alumina may be distinguished by its giving the peroxide of iron (when precipitated, as described, by ammonia and filtered) a very bulky and clayey appearance. If this precipitate be dissolved in muriatic acid, and the iron again precipitated by caustic potash, added in excess, and filtered, the alumina being now in solution passes through the filter, and may be again precipitated by adding ammonia. It is a bulky white precipitate.

### Chromium

Chromic acid ($H_2CrO_4$) crystallizes in fine red needles, which are obtained by freezing a solution of chromic anhydride in water. They are very soluble and deliquescent in water; they stain the skin yellow and when heated the crystals assume a very dark color and are afterward decomposed into sesquioxide of chromium and oxygen, often with incandescence. The aqueous solution of chromic acid had an orange red color; when exposed to sunlight it evolves oxygen and deposits the chromate of sesquioxide of chromium. Chromic acid is dissolved by weak alcohol, but the solution soon decomposes from the action of the chromic acid upon the alcohol. When absolute alcohol is poured upon crystals of chromic acid the former is rapidly oxidized, often with sufficient energy to give rise to combustion, the chromic acid being reduced to sesquichloride of chromium. Chromic acid is indeed one of the most powerful oxidizing agents with which we are acquainted.

When chromic acid is heated with hydrochloric acid, chlorine is evolved, and sesquichloride of chromium is formed. Sugar and many other organic substances are also capable of reducing this acid. When chromic acid (or bichromate of soda or potash) is heated with sulphuric acid (i. e., concentrated sulphuric) oxygen is evolved, so that a mixture of five parts of bichromate of soda and four of concentrated sulphuric acid has been recommended for the preparation of oxygen in the laboratory.

Chromic acid is extensively used as an oxidizing agent in experiments upon organic substances. It is mono-basic, and forms an extensive series of salts, which have the same crystalline form as the corresponding sulphates, chromic acid being isomorphous with sulphuric acid. The neutral chromates of the alkalies have a fine yellow color; the acid chromates are orange red.

Chromic acid is chiefly used as the source of a series of salts called chromates; the chromates are of three classes, viz., normal chromates, bichromates and basic chromates. The normal chromates of which potassium chromate ($K_2CrO_4$) and lead chromate are typical are yellow or red staple solids, which, with the exception of those of the alkali metals are insoluble in water. The bichromates are formed by the union of chromic anhydride with the normal chromates, and of them bichrome or bichromate of potassium ($K_2Cr_2O_7$) is the most characteristic, being a deep red crystalline solid that dissolves in water to an acid solution, with poisonous and powerfully oxidizing abilities. Bichrome, which is practically the source of the other chromates, is prepared on the large scale by heating chrome iron ore with quicklime and potassium carbonate in a current of air in a reverberatory furnace, whereupon potassium and calcium chromates are formed. These are dissolved out from the insoluble residues, principally formed of iron oxide, and treated with a solution of potassium sulphate, which converts the calcium chromate into potassium chromate, the calcium chromate being precipitated. The clear solution is then acted upon with enough sulphuric (or acetic) acid to set the chromic anhydride from part of the chromate, and this combines with the rest, on crystallization, to form bichrome.

The basic chromates, or compounds of normal chromates with excess of base, are represented by the chrome oranges or reds. The lead colors are typical of these and we need say no more about them in this paper. The insoluble chromates of lead, barium and zinc are useful only as pigments, while the soluble ones are used in dyeing and calico printing and for the preparation of the others.

According to the manufacturers, potassium bichromate or bichrome ($K_2Cr_2O_7$) is used in dyeing Aniline Black, for the aftertreatment of direct cotton dyestuffs, for the production of chrome yellow, cutch brown and logwood blacks, and 10 gallons of water at 212 deg. Fahr. dissolve 102 pounds of it.

Chromium Hydroxide or Chromic Hydroxide, $Cr_2(OH)_6$.—Chromium hydroxide is obtained by precipitating a solution of chromic alum with ammonia. Dissolved in acetic acid it forms chromium acetate.

Sesquioxide of chromium, like alumina, forms a series of alums, perfectly analogous to those of the latter base and made practically in the same way. Thus, chrome alum ($Cr_2(SO_4)_3K_2SO_4 + 24H_2O$) is used for the preparation of chromium mordants and in the aftertreatment of substantive cotton dyestuffs. This alum is very conveniently prepared by mixing the measures of a saturated solution of bichromate of potash with one measure of concentrate sulphuric acid and saturating with sulphurous acid; after a time crystals of chrome alum are deposited. Another method is to mix a concentrated solution of the bichromate with sulphuric acid, allowing the liquor to cool and gradually adding sugar, assisting the reaction with a gentle heat if necessary, till the red color of the solution has changed to violet; on standing the chrome alum is deposited. Alcohol may be used in place of sugar.

The chrome alum thus obtained is deposited in eight-sided crystals of a purple red color. It is very soluble in water, and when heated it undergoes the aqueous fusion, and at 390 deg. Fahr loses 22 egirs of water and is converted into a green modification. At about 662 deg. Fahr. it becomes anhydrous, and ultimately yields a lilac powder which is soluble only in oil of vitriol. Chrome alum is very soluble in water, and gives an acid solution of a dark violet color. It is insoluble in alcohol and is employed in dyeing, and is therefore an article of commerce.

The action of ammonia upon a solution of chrome alum tends to demonstrate the existence of different modifications of the hydrates of sesquioxide of chromium, corresponding to the sulphates. When a solution, drop by drop, is added to an excess of ammonia; the precipitated hydrate has a green color and yields a violet solution with sulphuric acid. If chrome alum be decomposed by a quantity of ammonia insufficient to redissolve any portion, the latter will have a violet color and will dissolve in sulphuric acid to form a red solution.

Chromium Acetate, $Cr_2(C_2H_6O_2)_6$.—Chromium acetate is prepared by the double decomposition of chrome alum and calcium acetate, or by the reduction of bichrome with glucose in the presence of acetic acid, or by dissolving chromium hydroxide in acetic acid. It is principally used as a mordant in calico printing.

Basic Chromium Acetate, $Cr_2(C_2H_3O_2)_4(OH)_2$.—Basic chrominom acetates are prepared by adding soda to normal chromium acetate. Chromium acetate is used in khaki dyeing.

Chromium Bisulphite, $Cr_2(HSO_3)_6$.—Chromium bisulphite is used as a mordant for alizarine colors. It is prepared by mixing a strong solution of chrome alum with an excess of bisulphite of soda.

Chromium Chloride, $Cr_2O_6$.—Chromium chloride is prepared by the double decomposition of chrome alum with calcium chloride, or by dissolving chromium hydroxide in hydrochloric acid. It is used as a mordant for alizarine colors.

Basic Chromium Chloride.—Obtained by dissolving chromium hydroxide in chromium chloride. It is used principally for mordanting cotton yarn.

Chromium Chromate or Chromium Mordant ($GA_1$, $GA_2$, $GA_3$, M. L. B).—The Hochst Farbwerke bring mordants under this name into the market which are prepared by dissolving chromium hydroxide in chromic acid. Chromium mordant, $GA_2$, which contains acetic acid, is especially suitable for mordanting cotton.

Chromium Fluoride, $CrF_3 + 4H_2O$.—Used for the aftertreatment of certain direct cotton and sulphur dyestuffs in order to improve the fastness to washing.

Then there is the sulphocyanide chromium mordant which gives the fullest and brightest shades, but the cost is prohibitive. Many of the alkaline mordants of chrome are the best, but it must be always remembered that the fixation of oxide of chrome is the leading consideration. The use of bichromate of soda is daily increasing in the practical field, and the more expensive bichromate of potash is being replaced. Whether or not on wool, lactic acid is better than cream of tartar or sulphuric acid, depends considerably upon the dye which is to be used. Dyes which alter with chromic acid, such a gallein, alizarine blue and cerulean, work well if sulphuric acid be employed in conjunction with lactic. With chrome as a bottom mordant on wool, 2½ to 4 per cent of bichromate of soda, 3 per cent of lactic acid (50 per cent) and 1 per cent of sulphuric acid work well. Chrome has always been considered the mordant for cotton, and 3 per cent bichromeate of soda and 1 per cent of sulphate of copper is about right for topping both black, brown or yellow, while the Amend process is good for wool. Again, all khakis on cotton are made with about 500 pounds chrome alum, and 250 pounds pyrolignite of iron mixed at 36 deg. Tw. or a mixture of the acetates of chromium and iron. In fact, chromium in one shape or another is used on both cotton and woolen goods in a thousand different ways and is a good mordant.

# Technical Notes from Foreign Sources

## Dyeing of Acetate Silk

A paper presented before the Society of Dyers and Colorists and published as an abstract in the Chemical Age of London, January 24, 1925, tells about the use of certain insoluble azo colors *in statu nascendi* for the dyeing of acetate silk. It was indicated that if the acetyl cellulose silk was immersed in a bath which contained dioxytartaric acid and phenylhydriazine in the presence of hydrochloric acid, the insoluble tartrazine which results was formed quantitatively on and in the fiber, which was dyed a particularly pure shade of yellow. By substituting paranitrophenylhydrazine for the phenylhydrazine an orange resulted. Similarly acetyl silk immersed in a bath containing nitrosamine, toluylenediamine and acetic acid, was dyed a rich terra cotta shade. Incidentally, it was pointed out that a solution of tartaric acid which had stood in contact with the air for some time, contained dioxytartaric acid.

## Errors in the Dyeing of Piece Goods

The dyer is generally inclined to trace errors and faults in the dyeing of cotton piece goods back to the preliminary treatment that the fabrics were subjected to before they came to him. While it is true that such is often the case, the trouble frequently lies in the dyeing process itself. For example, one of the most common causes of poor dyeing is the lack of proper care of the jigger. It is understandable that good results cannot be obtained with dirty rollers in the dyeing apparatus. When the jigger becomes old and gets into such a condition that it is often found necessary to discard a certain number of yards of the dyed fabric as unsalable, the question as to the purchase of a new machine in comparison with the cost of the same and the expense involved in spoiled fabrics is soon solved in fabor of getting a new machine.

It is a fact that the results obtained in dyeing practice depend to a large degree on the character of the dyestuff used in the process. The selection of the proper dyestuff and the method of applying it to the fabric is often left to the dyestuff manufacturer. Many dyers become accustomed to using certain dyeing methods and are loath to change to better methods. Furthermore, it is sometimes far more advisable to use a slop-padding machine than a jigger, but then again most dyers seem to think that the only machine to use is the latter. For example, the slop-padding machine is particularly well suited for the treatment of thick, closely woven fabrics through which the dyestuff penetrates with difficulty.

In this case the most advisable procedure is somewhat as follows About half of the coloring matter is dyed on the fabrics in the slop-padding machine and the remainder of the dyestuff is then applied in the regular dyeing jigger.

It need scarcely be mentioned that the concentration of the dye liquor is also of paramount importance in the dyeing of cotton piece goods. But then again the reason for imperfect dyeing is often found in the use of too dilute or too concentrated dye liquors. It is not sufficiently well understood or appreciated that when the dyeing is carried out with a liquor which is too concentrated the dyestuff goes on the fiber too quickly with the result that a fabric is obtained which is spotted with color. Particular attention must be given to the matter of dye liquor concentration when dyeing mercerized cotton fabrics which possess a very great affinity for the dyestuff. In fact, in this case good results are obtainable only when a dilute dye liquor is employed.

The same thing holds good when dyeing cotton fabrics with basic coloring matters on a tannin mordant. Here again the use of concentrated dye liquors is fraught with all sorts of disadvantages. Concentrated dye baths are advised only where substantive cotton colors are directly applied to the textile fabric. In any case the process should be tested out from time to time to see that conditions are proper for production of good dyeing results. (Deutsche Faerber Zeitung, 1925, 108.)

## Treating Artificial Silks for Dyeing

Cellulose esters, which are artificial silks, before and during dyeing are subjected to mild treatment with alkaline hydrolyzing agents in the presence of soluble aldehydes or hydroxyaldehydes or substances containing these in a loosely combined state. The aldehydes may be wholly or partially replaced by aromatic sulphonic or carboxylic acids or their salts, such as cresolsulphonic acids, naphthalene, sulphonic acids and naphthocarboxylic acids.

Variations in the quantity of the aldehyde or acid used during the treatment have marked effects upon the affinity of the fiber for the coloring matter and consequently on the depth of the color produced during the dyeing, and in cases where the fiber has some affinity for the dyestuff this can be annulled by using increased quantities of the aldehyde or the acid.

Various effects can thus be produced on fabrics which are made of fibers of different affinities for the dyestuff employed.

Examples are given illustrating the treatment, previous to dyeing, of cellulose acetate fabrics with formaldehyde and acetaldehyde in the presence of barium hydroxide, strontium hydroxide, and dilute sodium hydroxide solutions; with glyoxal sulphate, sodium glyoxylate, formaldehyde-bisulphite, acetaldehyde-bisulphite and formaldehyde sodium sulphoxylate in the presence of dilute sodium hydroxide solutions; with the calcium salt of the condensation product of formaldehyde and cresolsulphonic acid in the presence of dilute sodium hydroxide solutions;

and with the calcium salt of the condensation product of formaldehyde and naphthalene beta-sulphonic acid in the presence of calcium hydroxide.

Dyeing on mixed fabrics containing cotton and cellulose acetate fibers, in which the cellulose acetate remains uncolored, forming white effects on the colored cotton are produced, for example, by dyeing the fabric for one-quarter of an hour at a temperature of 75 deg. Cent. with 12 per cent of Kyrogene Black TBO in a bath containing sodium sulphide and 8 grams per liter of a mixed sodium para and meta-cresolsulphonates. (British Patent No. 209,849.)

### Vat Dyestuffs

One-aldehydonaphthalene-8-carboxylic acid is condensed with methyl or methylene compounds, and the products are fused with alkalies to yield vat dyestuffs which give very fast shades on cotton fabrics. For example, 1-aldehydenaphthalene-8-sulphonic acid is converted into its potassium salt and then condensed with benzyl cyanide and the resulting compound, when treated with concentrated sulphuric acid, gives 2-phenylperinaphthindone as yellow needles with a melting point of 142 deg. Cent. Either of these two compounds when fused with potassium hydroxide at 240 deg. Cent. yields a leuco compound from which a vat dyestuff is obtained on blowing in air. This dyestuff gives fast marine blue shades on cotton fabrics.

It may also be prepared by heating benzyl cyanide with the aldehyde-acid and with caustic potash. In place of benzyl cyanide, acetone, acetophenone or oxindole may be employed; in all cases the condensation occurs between the aldehyde group in the naphthalene derivative and the methylene or methyl group in the other compound. The dyestuff obtained from acetone gives greenish black shades on cotton. (German Patent No. 384,982.)

### Mordanting Wool with Chromium Compounds

An investigation of the degree and the rate of absorption of chromium by wool when mordanted by various methods is reported in the Journal of the Society of Dyers and Colorists, 194, pages 357-359.

The chomium content of the mordanted wool, of which the weight of sample usually taken was from 2 to 2½ grams, was determined by the oxidation of the ash with the aid of sodium peroxide, about 5 grams of the reagent being used. The product was then dissolved in sulphuric acid and subsequently titrated with standard solutions of ferrous ammonium sulphate and potassium permanganate.

Wool absorbs chromium more rapidly and in greater amount when mordanted with potassium dichromate and acetic acid; the less effective metachrome and chromosol methods give similar results. When wool was mordanted with 3 per cent of bichromate alone and also in the presence of 2.5 per cent of cream of tartar, 1 per cent of sulphuric acid, or 1 per cent of formic acid, the rate and degree of absorption of chromium increased in the order named. Under similar conditions the effectiveness of the chromosol method was between that of bichromate with 2.5 per cent of cream of tartar and with 1 per cent of sulphuric acid respectively.

### Indanthrene Blue Printing

The difficulty of printing deep solid shades of Indanthrene Blue S by a method in which tartaric acid is used is overcome by replacing tartaric acid with glucose. A satisfactory printing paste consists of 740 grams of an aqueous solution of gum, 125 grams of a 50 per cent solution of ferrous sulphate, 5 grams of tin salts (stannous chloride), 30 grams of ferrous sulphate, 50 grams of Indanthrene Blue S, 10 per cent paste, and 50 grams of glycerine. The paste gives good results and the success of the mixture is said to rest on the action of the glucose in protecting the dye from flocculation in the printing paste and not to its reducing power. (Bulletin Soc. Mulhouse, 1924, 554-555.)

### Treating Starch with Hydrogen Peroxide

Hydrogen peroxide is used in the preparation of starch pastes which are suitable for sizing and finishing fabrics. The pastes obtained in this manner are transparent and contain soluble starch which is produced by the action of the peroxide. The operation of making the starch preparation is carried out by heating an aqueous suspension of the starch containing a small amount of peroxide of hydrogen.

An example is given in the article contained in the Bulletin Soc. Mulhouse, 1924, 558-61. According to this example 40 kilograms of starch are boiled with an adequate amount of water which contains 600 c.c. of a neutral "5 vol." solution of peroxide of hydrogen or its equivalent of sodium peroxide. The product, which may be colored by means of dyestuff, such as Geranine or Chrysophenine, easily penetrates textile materials and is superior to the starch pastes prepared by means of malt extracts. When dried it yields a residue which is insoluble in water.

### Bucking and Bleaching Fabrics and Yarns

The goods are treated for a period of 24 hours with a solution containing sodium hydroxide, a rosin soap, sodium peroxide and lye from the next stage of the process. The turpentine derivatives in the rosin soap act as carriers for the active oxygen of the peroxide. The temperature rises and the bath gradually acquires an acid reaction. This treatment removes the non-cellulose constituents and loosens the fiber structure. The goods are then treated for 3 to 4 hours at 2.5 atmospheres pressure at the ordinary temperature with chlorine generated by the action of acid on sodium hypochlorite solution and are then heated at 63 deg. Cent. for 1.75 hours with a solution containing sodium peroxide, rosin soap, water glass, etc. (German Patent No. 388,925.)

## DYESTUFF TABLES

(*Continued from page* 163)

**Rubbing:** Fast.
**Steaming:** Fast.
**Washing:** Bleeds badly.
**Water:** Bleeds badly in water at 104 deg. Fahr.

**ON UNIONS:** No interest.

**ON OTHER MATERIALS:** No interest.

**COMPETING PRODUCTS:** Made in the United States by Croton Color & Chemical Company; National Aniline & Chemical Company.

### ANTHRACENE RED
**(Schultz No. 355)**

**COMPOSITION:** Disazo.

**SPECIALLY SUITABLE FOR:** Wool and silk.

**USUAL METHOD OF DYEING:** Glauber salt, acetic and sulphuric acid. Also dyes from a neutral bath.

**SHADE:** Bluish scarlet.

**SOLUBILITY:** Good.

**LEVEL:** Excellent.

**EXHAUSTS:** Slowly.

**FASTNESS TO:**
**Acid:** Fast.
**Alkali:** Shade goes bluer.
**Carbonizing:** Fast.
**Fuiling::** Very fast; does not stain whites.
**Light:** Fast.
**Potting:** Bleeds very slightly.
**Rubbing:** Fast.
**Scouring:** Fast.
**Steaming:** Excellent.
**Sulphur:** Fast.
**Washing:** Excellent.
**Water:** Fast.

**DYED BY OTHER METHODS:** Fastest dyed top chrome. Can also be dyed chrome mordant.

**COMPETING PRODUCTS:** Made in the United States by Newport Chemical Works, Inc.

### OXYDIAMINE ORANGE
**(Schultz No. 362)**

**COMPOSITION:** Disazo.

**SPECIALLY SUITABLE FOR:** Cotton.

**USUAL METHOD OF DYEING:** With common salt, with or without soda at the boil.

**SHADE:** Bright red shade of orange.

**SHADE BY GASLIGHT:** Redder.

**SOLUBILITY:** Good.

**LEVEL:** Fairly good.

**EXHAUSTS:** Well.

**FASTNESS TO:**
**Acid:** Acetic acid 12 deg. Tw. has no effect; goes red with 5 deg. Tw. muriatic.
**Alkali:** Good.
**Chlorine:** Will not stand.
**Fulling:** Fast when coupled; bleeds badly dyed direct.
**Ironing:** Fast.
**Light:** Fugitive.
**Rubbing:** Fast.
**Scouring:** Fast when coupled.
**Steaming:** Coupled with diazotized para, fast.
**Washing:** Moderate; same as average direct color. Coupled, O. K.; coupled with diazotized para, better; direct, poor.

**SENSITIVE TO METALS, LIME:** Not sensitive to copper.

**MACHINE DYEING:** Suitable.

**DYED BY OTHER METHODS:** Dyed cold. Coupled with diazotized para, gives reddish-brown shade faster to washing, fulling, etc.

**ON UNIONS:** Cotton-silk unions: Both fibers the same shade in a salt bath. Cotton-wool unions: Both fibers the same shade in a neutral bath.

**ON OTHER MATERIALS:** Silk: Dyed in a boiled-off liquor broken with acetic acid. Jute: Dyed with common salt. Paper: Suitable for blotting paper.

**DISCHARGING:** Neither the direct nor the coupled dyeing gives a good white with sulphoxalates.

**COMPETING PRODUCTS:** Made in the United States by National Aniline & Chemical Company; American Aniline Products, Inc.; Dye Products & Chemical Company.

## THE CHEMICAL EQUIPMENT EXPOSITION

A technical-industrial gathering of 1,000 persons, representing single plants and entire industries, the annual productive capacities of which run into billions of dollars, is assured in connection with the Chemical Equipment Exposition, to be held in Providence June 22-27, inclusive, 1925. This announcement is made by the Association of Chemical Equipment Manufacturers, the trade association of large equipment companies which is managing the exposition.

The exposition is indorsed by the Society of Chemical Industry, American Section, the American Association of Textile Chemists and Colorists, the New Jersey Chemical Society and other technical organizations. It is also announced that in conjunction with the exposition will be held regular sessions of the American Institute of Chemical Engineers, one of the country's major engineering societies, and a joint meeting of the Rhode Island and Northern New England Sections of the American Association of Textile Chemists and Colorists.

The exposition is designed solely for the benefit of industrial and technical men in the chemical and chemically-dependent industries. It will serve to introduce to manufacturers in many industries, not customarily thought of as "chemical," modern engineering processes

and equipment for performing profitable single or multiple chemical phases of production.

The chemically-controlled industries are: Heavy chemicals, fine chemicals, coal products, dye, fertilizer, explosives, alcohol, electrochemical, electrometallurgical, ferrous-metallurgy, non-ferrous-metallurgy, ceramics, petroleum, paper and pulp, rubber, paint and varnish, leather, lime and cement, soap, oil, sugar, food products, wood products, animal products. Each one of these industries is dependent upon chemical equipment, accessories, supplies and essential materials in some one or more of its phases.

The Chemical Equipment Exposition is supported by such companies as the Buffalo Foundry & Machine Company, the Bethlehem Foundry & Machine Company, General Ceramics Company, United Filters, Raymond Bros. Impact Pulverizer Company, Oliver Continuous Filter Company, Aluminum Company of America, Swenson Evaporator Company, the Dorr Company, Leeds & Northrup, Carbide & Carbon Chemical Corp., American Hard Rubber Company, Linde Air Products Company, United Lead Company, the Pfaudler Company, the Bristol Company, General Electric Company, Tolhurst Machine Company, U. S. Rubber Company, Duriron Company, Inc., International Nickel Company, etc. Many other nationally and internationally-known equipment companies are included.

The exposition will be held in the State Armory. The general headquarters of the association are 1328 Broadway, New York City.

## NEW DYESTUFF DEALERS

An announcement has been circulated throughout the trade by R. H. Schleicher & Co., Inc., 147 Spring Street, New York City, to the effect that this corporation has been formed for the purpose of dealing in dyestuffs and chemicals.

The personnel includes R. H. Schleicher, who was for fourteen years with the Berlin Aniline Works and more recently for seven years with American Aniline Products, Inc., and Henry L. Ludwig, who was for fifteen years chemist with Kalle & Co., and later for nine years president of Ludwig & Co., of New York City.

The Ciba Company, Inc., announces the removal of its Providence office and warehouse to larger and more convenient quarters at 61 Peck Street, Providence, R. I. Ralph F. Culver, vice-president, will remain in charge of this office.

Carbic Color & Chemical Company announce the opening of an office in Providence, R. I., located in the Union Trust Building, Westminster and Dorrance Streets. Herbert Kuhl has been appointed manager of this branch.

## NEWPORT DIRECT PINK 2B

Newport Chemical Works, Inc., have issued as an insert for their binder a leaflet describing Newport Direct Pink 2B, its application, notable properties and fastness qualities. This color is said to dye level and exhaust slowly. Its fastness to light, washing, alkalies and cross-dyeing is moderate. Its fastness to weak acids and hot pressing is described as good and to rubbing steaming as excellent. Union materials of cotton and wool are dyed about alike from boiling baths. If dyed from an alkaline soap bath at a temperature of 100 deg. Fahr., however, the animal fiber is practically unstained. The leaflet gives complete fastness properties and lists other dyestuffs of similar qualities suited for use with Newport Direct Pink 2B.

The National Aniline & Chemical Company has issued the new edition of Dyer's Formulas for use in connection with the 1925 Spring Season Shade Card of the Textile Color Card Association. Like previous editions this booklet contains complete dyeing formulas for silk, cotton and wool for each of the fifty-six colors listed in the spring shade card, and formulas for the fourteen additional wool colors, with detailed information on the proper dyeing methods for each class of fiber.


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